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DOCUMENTATION OF PROGRAM AFTBDY TO
GENERATE COORDINATE SYSTEM FOR 3-D
AFTER BODY USING BODY-FITTED CURVILINEAR
COORDINATES-Part I

Dilip Kumar

SYSTEMS AND APPLIED SCIENCES CORPORATION
Hampton, Virginia 23666

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ABSTRACT

The computer program AFTBDY generates a body-fitted curvilinear coordinate system for a wedge curved after body. (Figure 1). This wedge curved after body is being used in an experimental program at the Langley Research Center. The coordinate system generated by AFTBDY will be used to solve 3D compressible N.S. equations. The coordinate system in the physical plane is a cartesian x,y,z system, whereas, in the transformed plane a rectangular ξ,η,ζ system is used. The coordinate system generated is such that in the transformed plane coordinate spacing in the ξ,η,ζ direction is constant and equal to unity. The physical plane coordinate lines in the different regions are clustered heavily or sparsely depending on the regions where physical quantities to be solved for by the N.S. equations have high or low gradients. The coordinate distribution in the physical plane is such that x stays constant in η and ζ direction, whereas, z stays constant in ξ and η direction. The desired distribution in x and z is input to the program. Consequently, only the y -coordinate is solved for by the program AFTBDY.

List of Symbols

D	Physical Plane
D*	Transformed Plane
IMAX	Maximum number of points in ξ - direction
JMAX	Maximum number of points in η - direction
KMAX	Maximum number of points in ζ - direction
J	Jacobian
P,Q,R	Inhomogeneous terms used for coordinate attraction
S.O.R	Successive-Over-Relaxation iteration
x,y,z	Physical coordinates
ξ,η,ζ	Transformed coordinates
ϵ	Error criterion for convergence
$\Gamma_1, \Gamma_2, \Gamma_3,$ $\Gamma_4, \Gamma_5, \Gamma_6$	Boundary contour surfaces in the physical plane
$\Gamma_1^*, \Gamma_2^*, \Gamma_3^*,$ $\Gamma_4^*, \Gamma_5^*, \Gamma_6^*$	Boundary contour surfaces in the transformed plane
ω	Acceleration parameter for Gauss-Seidel iteration

Subscripts

$\xi, \eta, \zeta, x, y, z$	Denotes first partial differentiation
$\xi\xi, \eta\eta, xx, yy$ etc.	Denotes second partial differentiation
$\xi\eta, xy, xz$ etc.	Denotes corss partial differentiation

Superscripts (s)

Denotes iteration number

I. Numerical Generation of Body-Fitted Curvilinear Coordinate Systems

The method for numerically generating the Boundary-Fitted curvilinear coordinate system is presented as applicable in the case of the wedge-curved after body. The coordinate system generated is to be used to solve 3-D compressible Navier Stokes equations. The coordinate system in the physical plane is a cartesian x,y,z system, whereas in the transformed plane rectangular ξ,η,ζ system is used. The coordinate system generated is such that in the transformed plane, coordinate spacing in all three ξ,η,ζ direction is constant and equal to unity. The physical plane coordinate lines in the different directions are clustered heavily or sparsely depending on the regions where the physical quantities to be solved by the N.S. equations have large or small gradients. The coordinate distribution in the physical plane is such that x stays constant in η and ζ direction, whereas z stays constant in ξ and η direction. The desired distribution in x and z direction is input to the program. Consequently, only the y coordinate is solved for by the program AFTBDY. The clustering of points in y direction is specified by a point distribution on $\xi=1, \zeta=1$ line.

Section A provides a brief discussion of the mathematical formulation and section B describes the numerical technique used to generate the coordinate system.

A. Mathematics of Transformation

Consider the transformation of a simply connected 3-d region D (Figure 2), into a right angle parallelepoid region D* (Figure 3). We require that faces $\Gamma_1, \Gamma_2, \Gamma_3, \Gamma_4, \Gamma_5, \Gamma_6$ map into $\Gamma_1^*, \Gamma_2^*, \Gamma_3^*, \Gamma_4^*, \Gamma_5^*, \Gamma_6^*$ respectively. For identification purposes, region D is referred to as the physical plane, and D* as the transformed plane. In the D plane it is assumed that x is constant for a specified η and ζ and z is constant for a specified ξ and η . In the present problem only y is solved for since the desired distribution in x and z direction is input to the program. A 3-d formulation from x,y,z to ξ, η, ζ coordinates is defined as follows:

$$\begin{bmatrix} \xi \\ \eta \\ \zeta \end{bmatrix} = \begin{bmatrix} \xi(x,y,z) \\ \eta(x,y,z) \\ \zeta(x,y,z) \end{bmatrix} \quad (1)$$

The generating elliptic system is chosen to be the inhomogeneous Laplace equation,

$$\xi_{xx} + \xi_{yy} + \xi_{zz} = P(\xi, \eta, \zeta) \quad (2a)$$

$$\eta_{xx} + \eta_{yy} + \eta_{zz} = Q(\xi, \eta, \zeta) \quad (2b)$$

$$\zeta_{xx} + \zeta_{yy} + \zeta_{zz} = R(\xi, \eta, \zeta) \quad (2c)$$

with the following boundary conditions:

$$\Gamma_1 \quad \begin{bmatrix} \xi \\ \eta \\ \zeta \end{bmatrix} = \begin{bmatrix} \xi_1(x, y, z) \\ \eta_1(x, y, z) \\ \zeta_1 \end{bmatrix} \quad (3a)$$

$$\Gamma_2 \quad \begin{bmatrix} \xi \\ \eta \\ \zeta \end{bmatrix} = \begin{bmatrix} \xi_2 \\ \eta_2(x, y, z) \\ \zeta_2(z, y, z) \end{bmatrix} \quad (3b)$$

$$\Gamma_3 \quad \begin{bmatrix} \xi \\ \eta \\ \zeta \end{bmatrix} = \begin{bmatrix} \xi_3(x, y, z) \\ \eta_3 \\ \zeta_3(x, y, z) \end{bmatrix} \quad (3c)$$

$$\Gamma_4 \quad \begin{bmatrix} \xi \\ \eta \\ \zeta \end{bmatrix} = \begin{bmatrix} \xi_4(x, y, z) \\ \eta_4(x, y, z) \\ \zeta_4 \end{bmatrix} \quad (3d)$$

$$\Gamma_5 \quad \begin{bmatrix} \xi \\ \eta \\ \zeta \end{bmatrix} = \begin{bmatrix} \xi_5 \\ \eta_5(x, y, z) \\ \zeta_5(x, y, z) \end{bmatrix} \quad (3e)$$

$$\Gamma_6 \quad \begin{bmatrix} \xi \\ \eta \\ \zeta \end{bmatrix} = \begin{bmatrix} \xi_6(x, y, z) \\ \eta_6 \\ \zeta_6(z, y, z) \end{bmatrix} \quad (3f)$$

where $\zeta_1, \xi_2, \eta_3, \zeta_4, \xi_5, \eta_6$ are specified constants and

$\xi_1, \eta_1, \eta_2, \zeta_2, \xi_3, \zeta_3, \xi_4, \eta_4, \eta_5, \zeta_5, \xi_6$ and ζ_6 are

specified functions.

The inhomogeneous terms P, Q, and R are selected to control the spacing of $\eta = \text{constant}$ and $\zeta = \text{constant}$ lines in the physical plane and several forms for these terms can be used. In the present case a special form of P, Q and R was used based on the point distribution on ab, ac, and ae lines (Figure 2). (For convenience $\xi_2 = \eta_3 = \zeta_1 = 1$ and $\xi_5 = \text{IMAX}$, $\eta_6 = \text{JMAX}$ and $\zeta_4 = \text{KMAX}$ is chosen thus ensuring a field size of IMAX x JMAX x KMAX).

In order that the transformed plane contain a uniform grid, the dependent and independent variables must be interchanged in equations (2a), (2b) and (2c). The resulting equations are given by,

$$c_{11}x_{\xi\xi} - 2.0 c_{12}x_{\xi\eta} + 2.0 c_{13}x_{\xi\zeta} + c_{22}x_{\eta\eta} - 2.0 c_{23}x_{\eta\zeta} + c_{33}x_{\zeta\zeta} = -J^2(P(\xi, \eta, \zeta)x_{\xi} + Q(\xi, \eta, \zeta)x_{\eta} + R(\xi, \eta, \zeta)x_{\zeta}) \quad (4a)$$

$$c_{11}y_{\xi\xi} - 2.0 c_{12}y_{\xi\eta} + 2.0 c_{13}y_{\xi\zeta} + c_{22}y_{\eta\eta} - 2.0 c_{23}y_{\eta\zeta} + c_{33}y_{\zeta\zeta} = -J^2(P(\xi, \eta, \zeta)y_{\xi} + Q(\xi, \eta, \zeta)y_{\eta} + R(\xi, \eta, \zeta)y_{\zeta}) \quad (4b)$$

$$c_{11}z_{\xi\xi} - 2.0 c_{12}z_{\xi\eta} + 2.0 c_{13}z_{\xi\zeta} + c_{22}z_{\eta\eta} - 2.0 c_{23}z_{\eta\zeta} + c_{33}z_{\zeta\zeta} = -J^2(P(\xi, \eta, \zeta)z_{\xi} + Q(\xi, \eta, \zeta)z_{\eta} + R(\xi, \eta, \zeta)z_{\zeta}) \quad (4c)$$

where

$$c_{11} = (x_{\eta}y_{\zeta} - x_{\zeta}y_{\eta})^2 + (x_{\eta}z_{\zeta} - x_{\zeta}z_{\eta})^2 + (y_{\eta}z_{\zeta} - y_{\zeta}z_{\eta})^2 \quad (5a)$$

$$c_{12} = (x_{\xi}y_{\zeta} - x_{\zeta}y_{\xi}) * (x_{\xi}y_{\zeta} - x_{\zeta}y_{\eta}) + (x_{\xi}z_{\zeta} - x_{\zeta}z_{\xi}) * (x_{\eta}z_{\zeta} - x_{\zeta}z_{\eta}) + (y_{\xi}z_{\zeta} - y_{\zeta}z_{\xi}) * (y_{\eta}z_{\zeta} - y_{\zeta}z_{\eta}) \quad (5b)$$

$$c_{13} = (x_{\xi}y_{\eta} - x_{\eta}y_{\xi}) * (x_{\eta}y_{\zeta} - x_{\zeta}y_{\eta}) + (x_{\xi}z_{\eta} - x_{\eta}z_{\xi}) * (x_{\eta}z_{\zeta} - x_{\zeta}z_{\eta}) + (y_{\xi}z_{\eta} - y_{\eta}z_{\xi}) * (y_{\eta}z_{\zeta} - y_{\zeta}z_{\eta}) \quad (5c)$$

$$c_{22} = (x_{\xi}y_{\zeta} - x_{\zeta}y_{\xi})^2 + (x_{\xi}z_{\zeta} - x_{\zeta}z_{\xi})^2 + (y_{\xi}z_{\zeta} - y_{\zeta}z_{\xi})^2 \quad (5d)$$

$$c_{23} = (x_{\xi}y_{\eta} - x_{\eta}y_{\xi}) * (x_{\xi}y_{\zeta} - x_{\zeta}y_{\xi}) + (x_{\xi}z_{\eta} - x_{\eta}z_{\xi}) * (x_{\xi}z_{\zeta} - x_{\zeta}z_{\xi}) + (y_{\xi}z_{\eta} - y_{\eta}z_{\xi}) * (y_{\xi}z_{\zeta} - y_{\zeta}z_{\xi}) \quad (5e)$$

$$c_{33} = (x_{\xi}y_{\eta} - x_{\eta}y_{\xi})^2 + (x_{\xi}z_{\eta} - x_{\eta}z_{\xi})^2 + (y_{\xi}z_{\eta} - y_{\eta}z_{\xi})^2 \quad (5f)$$

$$J = x_{\xi}(y_{\eta}z_{\zeta} - z_{\eta}y_{\zeta}) - x_{\eta}(y_{\xi}z_{\zeta} - y_{\zeta}z_{\xi}) + x_{\zeta}(y_{\xi}z_{\eta} - y_{\eta}z_{\xi}) \quad (5g)$$

The boundary conditions transform as follows:

$$\text{on } \Gamma_1^*, \quad \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} a_1(\xi_1, \eta_1, \zeta_1) \\ a_2(\xi_1, \eta_1, \zeta_1) \\ a_3(\xi_1, \eta_1, \zeta_1) \end{bmatrix} \quad (6a)$$

$$\text{on } \Gamma_2^*, \quad \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} b_1(\xi_2, \eta_2, \zeta_2) \\ b_2(\xi_2, \eta_2, \zeta_2) \\ b_3(\xi_2, \eta_2, \zeta_2) \end{bmatrix} \quad (6b)$$

$$\text{on } \Gamma_3^*, \quad \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} c_1(\xi_3, \eta_3, \zeta_3) \\ c_2(\xi_3, \eta_3, \zeta_3) \\ c_3(\xi_3, \eta_3, \zeta_3) \end{bmatrix} \quad (6c)$$

$$\text{on } \Gamma_4^*, \quad \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} d_1(\xi_4, \eta_4, \zeta_4) \\ d_2(\xi_4, \eta_4, \zeta_4) \\ d_3(\xi_4, \eta_4, \zeta_4) \end{bmatrix} \quad (6d)$$

$$\text{on } \Gamma_5^*, \quad \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} e_1(\xi_5, \eta_5, \zeta_5) \\ e_2(\xi_5, \eta_5, \zeta_5) \\ e_3(\xi_5, \eta_5, \zeta_5) \end{bmatrix} \quad (6e)$$

$$\text{on } \Gamma_6^*, \quad \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} f_1(\xi_6, \eta_6, \zeta_6) \\ f_2(\xi_6, \eta_6, \zeta_6) \\ f_3(\xi_6, \eta_6, \zeta_6) \end{bmatrix} \quad (6f)$$

The functions a, b, c, d, e, f are specified by the known surfaces $\Gamma_1, \Gamma_2, \Gamma_3, \Gamma_4, \Gamma_5$ and Γ_6 . On all six surfaces $\Gamma_1, \Gamma_2, \Gamma_3, \Gamma_4, \Gamma_5$ and Γ_6 Dirichlet boundary conditions are used.

As indicated before, in the present problem only y is solved for since the desired distribution in x and z is input to the program. The last aspect to be discussed is how P, Q and R are computed. P is computed based on x variation of points on line ab (Figure 2). Similarly, Q and R are computed based on y, z variation on line ac and ae , respectively. The following discussion will make this point clearer.

If one assumes on ab that the y and z variation is zero ($y_\xi = z_\xi = 0$), on ac x and z variation is zero ($x_\eta = z_\eta = 0$), and on ae x and y variation is zero ($x_\zeta = y_\zeta = 0$) then from equations (4) and (5) we obtain

$$P(\xi, \eta, \zeta) = - \frac{x_{\xi\xi}}{3x_\xi} \quad (7a)$$

$$Q(\xi, \eta, \zeta) = - \frac{y_{\eta\eta}}{3y_\eta} \quad (7b)$$

$$R(\xi, \eta, \zeta) = - \frac{z_{\zeta\zeta}}{3z_\zeta} \quad (7c)$$

Notice P, Q , and R are functions of ξ, η , and ζ , respectively. Thus only one dimensional arrays of size $IMAX, JMAX, KMAX$ are required to store P, Q , and R , respectively.

B. Numerical Solution Techniques

Based on the above discussion equation (4b) must be numerically solved. The coefficients C_{ij} are given by equations (5) and P, Q, R are given by equations (7). The numerical solution of the transformation can be easily performed. First P, Q, and R are computed as follows:

$$P(I) = \frac{x(I+1,1,1) - 2x(I,1,1) + x(I-1,1,1)}{(x(I+1,1,1) - x(I-1,1,1))^{**3}} \quad (8a)$$

$$2 \leq I \leq I_{MAX}-1$$

$$Q(J) = \frac{y(1,J+1,1) - 2y(1,J,1) + y(1,J-1,1)}{(y(1,J+1,1) - y(1,J-1,1))^{**3}} \quad (8b)$$

$$2 \leq J \leq J_{MAX}-1$$

$$R(K) = \frac{z(1,1,K+1) - 2z(1,1,K) + z(1,1,K-1)}{(z(1,1,K+1) - z(1,1,K-1))^{**3}} \quad (8c)$$

$$2 \leq K \leq K_{MAX}-1$$

A S.O.R Gauss Seidell iteration is used to numerically solve equation (4b). All derivatives in (4b) are written in second order central difference form. Then following expression for intermediate value of y at point (I, J, K) is obtained,

$$\begin{aligned} \bar{y}(I,J,K) = CF * [& c_{11}(y(I+1,J,K) + y(I-1,J,K)) - 2 c_{12}y_{\xi\eta} \\ & + 2c_{13}y_{\xi\zeta} + c_{22}(y(I,J+1,K) + y(I,J-1,K)) \\ & + c_{33}(y(I,J,K+1) + y(I,J,K-1)) - 2 c_{23}y_{\eta\zeta} + \\ & J^2(P(I)y_{\xi} + Q(J)y_{\eta} + R(K)y_{\zeta})] \end{aligned} \quad (9a)$$

where

$$C_F = 0.5/(c_{11} + c_{22} + c_{33}) \quad (9b)$$

In (9a) we have $2 \leq I \leq \text{IMAX}-1$, $2 \leq J \leq \text{JMAX}-1$ and $2 \leq K \leq \text{KMAX}-1$.

In addition c_{11} , c_{12} etc. are given by equation (5). If f denotes x , y , or z then the derivatives of x , y , z in difference form required for equation (9a) are given by,

$$f_{\xi} = 0.5(f(I+1, J, K) - f(I-1, J, K)) \quad (10a)$$

$$f_{\eta} = 0.5(f(I, J+1, K) - f(I, J-1, K)) \quad (10b)$$

$$f_{\zeta} = 0.5(f(I, J, K+1) - f(I, J, K-1)) \quad (10c)$$

$$f_{\xi\eta} = 0.25(f(I+1, J+1, K) - f(I-1, J+1, K) - f(I+1, J-1, K) + f(I-1, J-1, K)) \quad (10d)$$

$$f_{\eta\zeta} = 0.25(f(I, J+1, K+1) - f(I, J-1, K+1) - f(I, J+1, K-1) + f(I, J-1, K-1)) \quad (10e)$$

$$f_{\xi\zeta} = 0.25(f(I+1, J, K+1) - f(I-1, J, K+1) - f(I+1, J, K-1) + f(I-1, J, K-1)) \quad (10f)$$

$$f_{\xi\xi} = f(I+1, J, K) - 2f(I, J, K) + f(I-1, J, K) \quad (10g)$$

$$f_{\eta\eta} = f(I, J+1, K) - 2f(I, J, K) + f(I, J-1, K) \quad (10h)$$

$$f_{\zeta\zeta} = f(I, J, K+1) - 2f(I, J, K) + f(I, J, K-1) \quad (10j)$$

If (9a) is the intermediate value for S.O.R iteration then value of y at the next iteration ($S + 1$) is as follows:

$$y^{(s+1)}(I,J,K) = (1-w) y^{(s)}(I,J,K) + w \bar{y}(I,J,K) \quad (11)$$

In equations (9) and (10) most current iterative value of y are used and w is the acceleration parameter.

In equations (9) and (10) most current iterative value of y are used and w is the acceleration parameter.

The convergence is reached whenever the absolute value of $y(I, J, K)^{(S+1)} - y(I, J, K)^{(S)}$ is less than a specified quantity ϵ . Generally a value of 0.000005 to 0.00001 is specified for ϵ . A value of 0.4 to 0.8 is used for w .

C. Initial Guess and Boundary Point Specification

The input to the program consists of x coordinate specification on line ab , y specification on line ac , and z specification on line ae . This implies that $\{x(I,1,1), 1 \leq I \leq I_{MAX}\}$, $\{y(1,J,1), 1 \leq J \leq J_{MAX}\}$ and $\{z(1,1,K), 1 \leq K \leq K_{MAX}\}$ are known. (The program is written for a body for which x varies from 0 to 90.0, and z varies from 0 to 12.0). The initial guess is specified as follows,

$$x(I,J,K) = x(I,1,1) \quad (12a)$$

$$z(I,J,K) = z(1,1,K) \quad (12b)$$

where $1 \leq I \leq I_{MAX}$, $1 \leq J \leq J_{MAX}$, $1 \leq K \leq K_{MAX}$.

The y coordinates are specified as follows. On surface Γ_6 ($J=J_{MAX}$) the coordinates are given by,

$$y(I,J_{MAX},K) = y(1,J_{MAX},1) \quad (13a)$$

$1 \leq I \leq I_{MAX}$ and $1 \leq K \leq K_{MAX}$.

on Γ_3 (J =1) y coordinate is specified as follows:

$$y(I,1,1) = x(I,1,1) * \tan(4^\circ) \quad \text{if } x(I,1,1) \leq 62.3 \quad (13b)$$

$$y(I,1,1) = C + [D^2 - (x(I,1,1) - E)^2]^{0.5} \quad \text{if } x(I,1,1) > 62.3 \quad (13c)$$

$$C = -457.8350$$

$$D = 463.3164$$

also $E = 94.56704$

$$y(I,1,K) = y(I,1,1) \quad \text{if } x \leq 62.3 \quad (13d)$$

and

$$y(I,1,K) = y(I,1,1) - R + [R^2 - z^2]^{1/2} \quad \text{if } x > 62.3 \quad (13e)$$

$$R = [A + B(x(I,1,1) - 62.3)]^{0.5}$$

$$A = 0.00035521$$

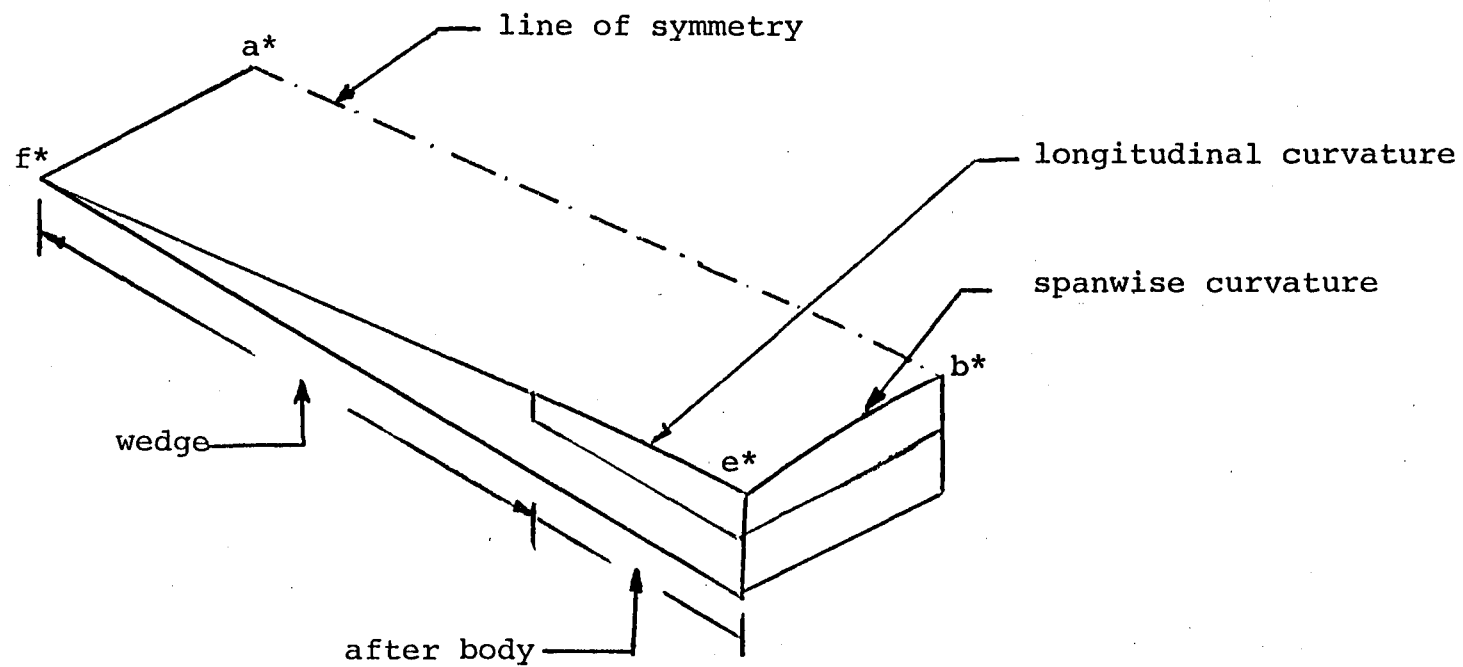
$$B = 0.000223505$$

$$2 \leq I \leq \text{IMAX} \text{ and } 2 \leq K \leq \text{KMAX}.$$

y on remaining of the points is given as follows:

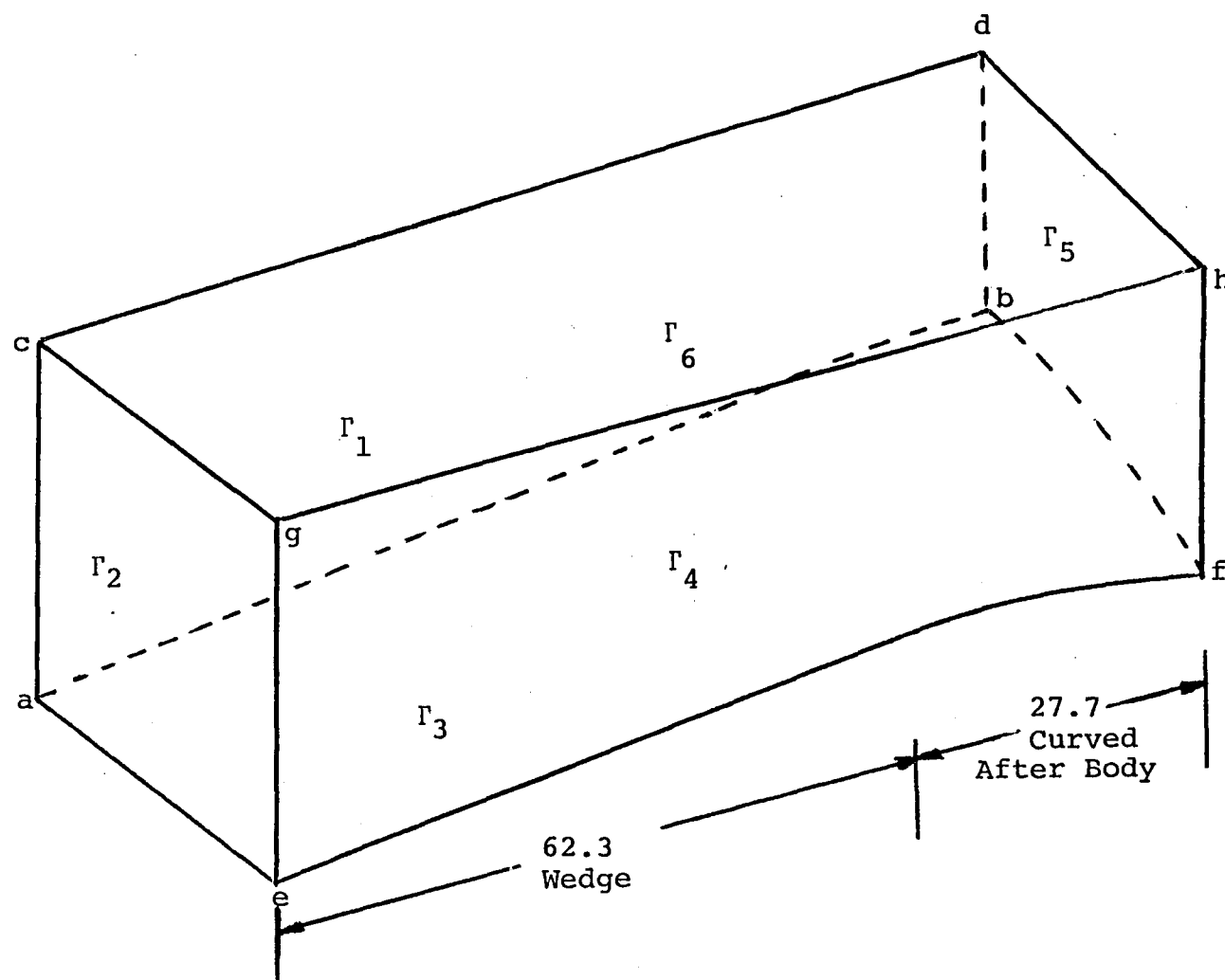
$$y(I,J,K) = y(I,1,K) + (y(I,\text{JMAX},K) - y(I,1,K)) * \frac{(y(1,J,1) - y(1,1,1))}{y(1,\text{JMAX},1) - y(1,1,1)} \quad (13f)$$

$$1 \leq I \leq \text{IMAX}, \quad 2 \leq J \leq \text{JMAX}-1 \text{ and } 1 \leq K \leq \text{KMAX}$$



note: $a^* e^* f^* b^*$ is surface $aefb$ in figure 2.

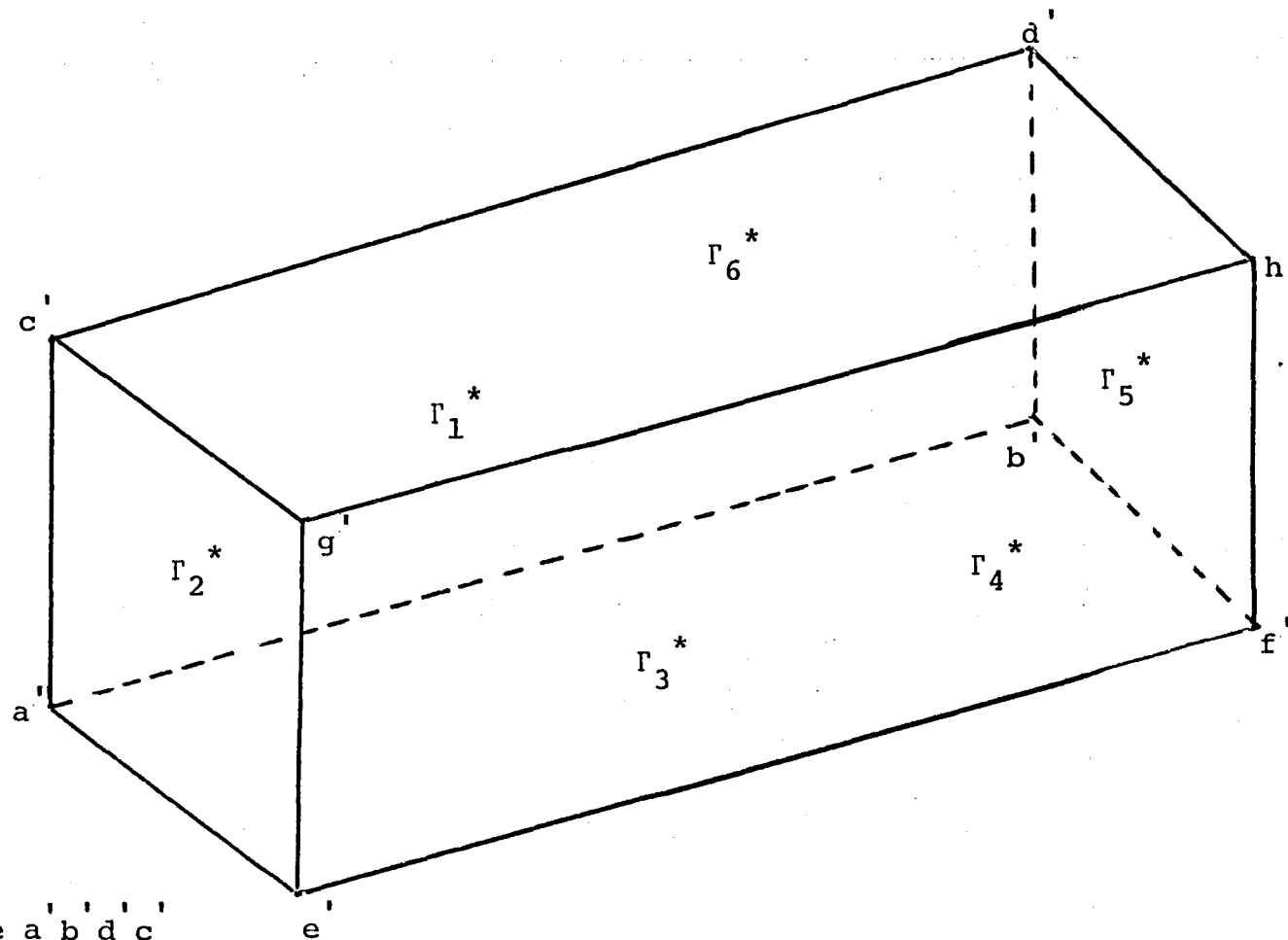
Figure 1. Wedge Curve After Body



- Γ_1 - surface abdc
- Γ_2 - surface aegc
- Γ_3 - surface aefb
- Γ_4 - surface efhg
- Γ_5 - surface bfhd
- Γ_6 - surface cghd

Physical Plane

Figure 2. (continued)



- Γ_1 - surface a' b' d' c'
- Γ_2 - surface a' e' g' c'
- Γ_3 - surface a' e' f' b'
- Γ_4 - surface e' f' h' g'
- Γ_5 - surface b' f' h' d'
- Γ_6 - surface c' g' h' d'

Transformed Plane

Figure 2. Coordinate Transformation

II. Computer Program

A. Program Listing

A computer program to numerically generate boundary-fitted coordinate system for a wedge after body combination was written in FORTRAN IV language to run on the LaRC CDC NOS system complex. The computer program consists of the main program AFTBDY and subroutines INIT, CALCOR, IPRTC, and IPLTC. A brief description of the main program and the four subroutines is provided in Chapter IV. The program listing follows this page.

```

***** *DECK AFTBDY
        PROGRAM AFTBDY(INPUT,OUTPUT,SOLNXX,TAPE1=SOLNXX,TAPE5=INPUT,
        1 TAPE6=OUTPUT)
C*****
C**
C**      THIS PROGRAM GENERATES COORDINATE SYSTEM FOR A 3-D AFTER
C**      BODY. THE COORDINATES GENERATED ARE BASED ON THE METHOD
C**      DEVELOPED BY THOMPSON, THAMES AND MASTIN OF MISSISSIPPI
C**      STATE UNIVERSITY.
C**
C**      FOR FURTHER ENQUIRIES CONTACT :
C**
C**      DR. DILIP KUMAR
C**      DR. JULIUS HARRIS
C**      NASA - LANGLEY RESEARCH CENTER
C**      MAIL STOP 163
C**      HAMPTON, VA 23665
C**      PHONE: 804-827-3696
C**      FTS CODE 928-1110
C**
C*****
C**
C**      THIS PROGRAM GENERATES COORDINATES FOR A AFTER BODY. DUE
C**      TO SYMMETRY ONLY HALF OF THE BODY IS CONSIDERED. THE
C**      COORDINATES IN X AND Z DIRECTION ARE FIXED. SOLUTION IS
C**      OBTAINED FOR Y ONLY. THE DESIRED DISTRIBUTION OF POINTS
C**      IS DEFINED ON J=1,K=1 AND I = 1,IMAX POINTS, THEN ON
C**      I=1,K=1 AND J=1,JMAX AND FINALLY ON I=1,J=1 AND K=1,KMAX.
C**      THIS DISTRIBUTION CAN BE SPECIFIED BASED ON UNIFORM,
C**      EXPONENTIAL, OR POLYNOMIAL DISTRIBUTION. BASED ON THIS
C**      DISTRIBUTION THE ATTRACTION COEFFICIENTS P,Q, AND R ARE
C**      COMPUTED. THE DISTRIBUTION OF POINTS MUST BE SPECIFIED
C**      SO THAT P,Q,AND R ARE CONTINUOUS. BASED ON THESE P,Q,AND R
C**      THEN Y COORDINATE IS COMPUTED.
C**
C**      --- CARD INPUT ---
C**
C**      CARD1 : SPECIFIES GRID SIZE
C**      ++ IMAX,JMAX,KMAX (FORMAT 3I5)
C**      IMAX : NO OF NODES IN X-DIRECTION
C**      JMAX : NO OF NODES IN Y-DIRECTION
C**      KMAX : NO OF NODES IN Z-DIRECTION
C**
C**      CARD2 : GAUSS-SEIDELL PAR.,CONVERGENCE CRITERION, ERROR

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C**      PRINT FREQUENCY FLAG, AND MAXIMUM NO OF ITERATIONS
C**      ++ R1,R2,R3,R4,IERR,ITERMX (FORMAT 4F10.0,2I5)
C**      R1 : GAUSS SEIDELL ITERATION PARAMETER
C**            (USUALLY 0.6)
C**      R2,R3 : MAXIMUM ERROR ALLOWED IN X,Y,AND Z DIRECTION
C**      R4 : RESPECTIVELY (USUALLY 0.000005 TO 0.00001)
C**      IERR : INTERVAL AT WHICH MAX ERROR IS PRINTED.
C**      ITERMX: MAXIMUM NUMBER OF ITERATIONS PERFORMED.
C**
C**      CARD3 : BOUNDARY POINT COORDINATES
C**      X,Y,Z (FORMAT 3F10.0)
C**      ++ THERE ARE IMAX+JMAX+KMAX SUCH CARDS. IMAX CARDS ARE
C**      INPUT FOR J=1,K=1 AND I=1 TO IMAX. SIMILARY CARDS
C**      FOR I=1,K=1,J=1 TO JMAX AND I=1,J=1,K=1 TO KMAX ARE
C**      INPUT. FOR IMAX CARDS ONLY X IS INPUT,
C**      FOR JMAX CARD Y, AND KMAX CARDS ONLY Z IS INPUT.
C**      OTHER COORDINATES ARE LEFT BLANK AND ARE COMPUTED
C**      BY THE PROGRAM.
C**      CARD4 : PRINT OPTION PARAMETERS
C**      IPRT1,IDE11,JDEL1,IPRT2,IDE12,JDEL2 (FORMAT 6I5)
C**      ++ IPRT1 : PRINT INITIAL GUESS 0-NO 1-YES.
C**      IDE11 : INTERVAL OF I AT WHICH INITIAL GUESS IS
C**      PRINTED. 1 MEANS FOR EVERY 1, 2 MEANS FOR I=
C**      1,3,5,7 AND SO ON.
C**      JDEL1 : INTERVAL OF J-COORDINATE FOR WHICH INITIAL
C**      GUESS IS PRINTED.
C**      IPRT2 : SAME AS IPRT1,IDE11,JDEL1 FOR CONVERGED OR
C**      IDE12 PARTIALLY CONVERGED SOLUTION. PARTIALLY
C**      JDEL2 CONVERGED SOLUTION IS PRINTED IN CASE THE
C**      SOLUTION DOES NOT CONVERGE AFTER ITERMX
C**      ITERATIONS.
C**
C**      CARD5 : HEADER CARD
C**      HED1(I),I=1,4 (FORMAT 4A10)
C**      ++ HED1 : 40 BYTES OF HEADER INFO PRINTED ON COORDINATE
C**      PRINTOUT AND PLOTS
C**
C**      CARD6 : ADDITIONAL HEADER CARD
C**      HED2(I),I=1,4 (FORMAT 4A10)
C**      SAME AS CARD5. (BOTH CARD5 AND CARD6 REQUIRED)
C**
C**      CARD7 : INITIAL GUESS PLOT OPTION
C**      NPLT1 (FORMAT I5)

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C** ++ NPLT1 : SPECIFIES NUMBER OF SURFACES FOR WHICH
 C** INITIAL GUESS IS PLOTTED.
 C**
 C** CARD8 : THERE ARE NPLT1 CARD TYPE 8. THESE CARDS SPECIFY
 C** VARIOUS SURFACES THAT NEED TO BE PLOTTED.
 C** ITYPE,ISTN,SIZE1 (FORMAT 2I5,F10.0)
 C** ++ ITYPE : TYPE OF SURFACE . = 1 I STATION. = 2 K STATION
 C** ISTN : VALUE OF I OR K STATION DEPENDING ON ITYPE.
 C** SIZE1 : MAX PLOT SIZE IN Z DIRECTION IF ITYPE = 1,
 C** OR MAX PLOT SIZE IN X-DIRECTION IF ITYPE = 2.
 C**
 C** CARD9 : SIMILAR TO CARD TYPE 7 AND 8 RESPECTIVELY FOR
 C** CARD10 CONVERGED OR PARTIALLY CONVERGED SOLUTION.
 C**
 C**
 C** *** SAMPLE RUNSTREAM

C** AFTBDY,T7777,CM320000.
 C** USER,479019C.
 C** CHARGE,100718,LRC.
 C** GET(OLDPL=AFTBDY/UN=375732N).
 C** UPDATE(F,C=VISFL1).
 C** COPYBR,INPUT,EDTFT1.
 C** REWIND,VISFL1,EDTFT1.
 C** EDIT,VISFL1,I=EDTFT1.
 C** REWIND,VISFL1.
 C** FTN(PL=77777,I=VISFL1).
 C** ATTACH,LRCGOSF/UN=LIBRARY,NA.
 C** LDSET,LIB=LRCGOSF,PRESET=ZERO.
 C** LGO.
 C** PLOT.VARIAN
 C** REWIND,SOLNXX.
 C** COPYBR,SOLNXX,AFSOLN.
 C** REWIND,AFSOLN.
 C** SAVE,AFSOLN.
 C** 7/8/9
 C** *IDENT DUH1
 C** *INSERT AFTBDY.4
 C** C**
 C** 7/8/9
 C** RS:/ MXLL/,/ 26/;
 C** RS:/ MXLL/,/ 26/;
 C** RS:/ MXLL/,/ 21/;

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C**      END
C**      7/8/9
C**      INPUT DATA. SEE EXPLANATION ABOVE.
C**      6/7/8/9
C**      NOTE: AFTER FIRST 7/8/9 CARD 3 CARDS ARE INPUT TO
C**             SATISFY INPUT FOR UPDATE UTILITY.
C**
C**      AFTER 2ND 7/8/9 CARD EDIT CARDS ARE INPUT. THE
C**      PROGRAM IS WRITTEN SO THAT MAXIMUM NUMBER OF
C**      POINTS IN X,Y,Z DIRECTION CAN BE CHANGED BY SIMPLE
C**      INPUT. IN THE ABOVE CASE FIELD SIZE OF 26,26,21
C**      IS ASSUMED. IN THE THREE CARDS AFTER RS1/ AND MXLL
C**      I,J,K SHOULD BE INPUT RESPECTIVELY. THIS COULD NOT
C**      BE SHOWN ABOVE BECAUSE TEXT EDITOR CHANGES TEXT IN
C**      COMMENTS CARDS ALSO.
C**
C**      IT IS ASSUMED THAT PROGRAM RESIDES ON FILE AFTBDY
C**      UNDER USER NO. OF 375732N AND USER 479019C HAS
C**      PERMISSION TO USE IT. FURTHERMORE, IT IS ALSO ASSUMED
C**      THAT THE COORDINATE SYSTEM SOLUTION IS TO BE STORED
C**      ON FILE AFSOLN. THIS NAME CAN BE CHANGED BY
C**      CHANGING THREE CARDS TOWARDS THE END OF THE RUNSTREAM.
C**
C**      THE PLOTS ON CALCOMP CAN BE OBTAINED BY REPLACING
C**      PLOT.VARIAN CARD BY FOLLOWING CARDS.
C**      PLOT.CALPOST,11(X0=1.0,Y0=0.2)
C**      CONT. //PAPER 00,
C**      CONT. LEROY PEN SIZE 0.3
C**      CONT. MULTIPLE PLOT MODE
C**      CONT. THESE PLOTS ARE FOR REPORTS//
C**
C**      COMMON /BXXX/ X(IMXLL,JMXLL,KMXLL),Y(IMXLL,JMXLL,KMXLL),
C**      1 Z(IMXLL,JMXLL,KMXLL),P(IMXLL),Q(JMXLL),R(KMXLL)
C**      COMMON /AXXX/ IMAX,JMAX,KMAX,ILIMIT,JLIMIT,KLIMIT,ISOLN,
C**      1 KKK,XERRMX,YERRMX,ZERRMX,IXERI,IXERJ,IXERK,IYERI,IYERJ,
C**      2 IYERK,IZERI,IZERJ,IZERK,R1,R2,R3,R4,IERR,ITERMX,IPRT1,
C**      3 IDEL1,JDEL1,IPRT2,IOEL2,JOEL2,NPLT1,ITYPE,ISTN,SIZE1,
C**      4 SIZE2,LL,HED1(4),HED2(4),IPLSET,FILLXX(25)
C**      DATA KKK,IXERI,IXERJ,IXERK,IYERI,IYERJ,IYERK,IZERI,IZERJ,IZERK,
C**      1 XERRMX,YERRMX,ZERRMX,IPLSET/10*0,3*0.0,0/
C**
C**      ILIMIT = IMXLL
C**      JLIMIT = JMXLL

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KLIMIT = KMXLL
C**
C**      INITIALIZE X,Y,Z AND P,Q,R ARRAYS TO 0.
C**
DO 10 I = 1,ILIMIT
  P(I) = 0.0
10 CONTINUE
DO 20 J = 1,JLIMIT
  Q(J) = 0.0
20 CONTINUE
DO 30 K = 1,KLIMIT
  R(K) = 0.0
30 CONTINUE
C**
DO 50 I = 1,ILIMIT
  DO 50 J = 1,JLIMIT
    DO 50 K = 1,KLIMIT
      X(I,J,K) = 0.0
      Y(I,J,K) = 0.0
      Z(I,J,K) = 0.0
50 CONTINUE
C**
C**      READ PART OF INPUT AND CHECK FOR GRID SIZE. PLOT CARDS ARE
C**      READ IN IPLTC ROUTINES.
C**
READ(5,1000) IMAX,JMAX,KMAX
WRITE(6,1010)
WRITE(6,1020) IMAX,JMAX,KMAX
IF(IMAX.GT.ILIMIT) GO TO 80
IF(JMAX.GT.JLIMIT) GO TO 80
IF(KMAX.GT.KLIMIT) GO TO 80
GO TO 100
C**
C**      GRID SIZE SPECIFIED TOO LARGE
C**
80 CONTINUE
  WRITE(6,1030) IMAX,JMAX,KMAX,ILIMIT,JLIMIT,KLIMIT
  STOP
100 CONTINUE
C**
READ(5,1040) R1,R2,R3,R4,IERR,ITERMX
WRITE(6,1050) R1,R2,R3,R4,IERR,ITERMX
READ(5,1060) ((X(I,1,1),Y(I,1,1),Z(I,1,1)),I=1,IMAX)
READ(5,1060) ((X(1,J,1),Y(1,J,1),Z(1,J,1)),J=1,JMAX)
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READ(5,1060) ((X(1,1,K),Y(1,1,K),Z(1,1,K)),K=1,KMAX)
READ(5,1000) IPRT1,IDEL1,JDEL1,IPRT2,IDEL2,JDEL2
WRITE(6,1070) IPRT1,IDEL1,JDEL1,IPRT2,IDEL2,JDEL2
READ(5,1080) (HED1(I),I=1,4)
WRITE(6,1090) (HED1(I),I=1,4)
READ(5,1080) (HED2(I),I=1,4)
WRITE(6,1100) (HED2(I),I=1,4)

C**
C**      CALL INIT TO SET UP INITIAL GUESS AND COMPUTE P,Q,R
C**
C**      CALL INIT
C**
C**      CALL IPRTC TO PRINT INITIAL GUESS IF IPRT1 SET.
C**
C**      ISOLN = 0
C**      CALL IPRTC
C**
C**      CALL IPLTC FOR PLOTTING INITIAL GUESS IF OPTIONS SET.
C**
C**      CALL IPLTC
C**
C**      COMPUTE COORDINATE SYSTEM
C**
C**      CALL CALCOR
C**
C**      CALL IPRTC AND IPLTC TO PRINT,PLOT CONVERGED OR
C**      PARTIALLY CONVERGED SOLUTION IF PROPER OPTIONS SET.
C**
C**      ISOLN = 1
C**      CALL IPRTC
C**      CALL IPLTC
C**
C**      STORE CONVERGED SOLUTION.
C**
C**      IF(KKK.EQ.0) GO TO 150
C**      WRITE(1,1110) ILIMIT,JLIMIT,KLIMIT,IMAX,JMAX,KMAX,
C**      1 ((HED1(I),HED2(I)),I=1,4)
C**      WRITE(1,1120) (((X(I,J,K),Y(I,J,K),Z(I,J,K)),K=1,KLIMIT),
C**      1 J=1,JLIMIT),I=1,ILIMIT)
C**      GO TO 200
C**
C**      SOLUTION DID NOT CONVERGE. WRITE A MESSAGE.
C**
C**      150 CONTINUE

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WRITE(6,1130) YERRMX,IYERI,IYERJ,IYERK,R3,ITERMX
C**
C**      ALL FUNCTION COMPLETE
C**
200 CONTINUE
STOP
C**
C**      ALL FUNCTIONS COMPLETE.  FORMAT STATEMENTS
C**
1000 FORMAT(16I5)
1010 FORMAT("1")
1020 FORMAT("0",5X,"IMAX,JMAX,KMAX = ",3I5)
1030 FORMAT(///5X,"*** GRID SIZE LARGER THAN ALLOWED",
1      /5X,"*** GRID SIZE INPUT      = ",3I5,
2      /5X,"*** LARGEST SIZE ALLOWED = ",3I5,
3      /5X,"*** INCREASE VALUE OF IMXLL,JMXLL,KMXLL IN TEXT",
4      "  EDITOR",
5      /5X,"*** RUN ABORTED ")
1040 FORMAT(4F10.0,2I5)
1050 FORMAT("0",5X,"R1,R2,R3,R4,IERR,ITERMX = ",4E15.5,2I5)
1060 FORMAT(3F10.0)
1070 FORMAT("0",5X,"IPRT1,IDE11,JDEL1,IPRT2,IDE12,JDEL2 = ",6I5)
1080 FORMAT(4A10)
1090 FORMAT("0",5X,"HED1 = ",4A10)
1100 FORMAT("0",5X,"HED2 = ",4A10)
1110 FORMAT(6I5,8A10)
1120 FORMAT(1X,8E15.8)
1130 FORMAT("1"///5X,"*** SOLUTION DID NOT CONVERGE. SOLUTION",
1      " NOT STORED ON UNIT 1"//5X,"*** MAX ERROR IN Y = ",E15.6,
2      " OCCURED AT LOCATION = ",I5," ",I5," ",I5//5X,"*** MAX",
3      " ERROR ALLOWED = ",E15.6//5X,"*** NO. OF ITERATIONS",
4      " PERFORMED = ",I5)
C**
C**      END
C**      SUBROUTINE INIT
C**
C**      THIS SUBROUTINE COMPUTES INITIAL GUESS ON THE AFTER BODY
C**      MODEL. ONLY ONE-HALF OF THE BODY IS CONSIDERED. THE BODY
C**      CONSISTS OF A 4-DEGREE WEDGE SECTION AND A AFTER BODY
C**      WHICH IS CURVED IN X AS WELL AS Z-DIRECTION. THE WEDGE
C**      HAS A LENGTH OF 62.3 AND THE AFT BODY HAS A LENGTH OF
C**      27.7. THE HALF WIDTH IS 12. IN THE AFTER BODY
C**      Y-CENTERLINE (YCL) IS GIVEN BY
C**       $YCL = C + (D*D - (X-E)*(X-E))*0.5$ 

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REACTION RUN

CARDS ENCOUNTERED IN INPUT

UPDATE 1.2-452.

79/06/22. 18.29.34.

PAGE 8

C** WHERE C = -457.8350
 C** D = 463.3164
 C** E = 94.56704
 C**
 C** IN LATERAL DIRECTION
 C** Y = YCL - R + (R*R - Z*Z) ** 0.5
 C** WHERE R = (A+B(Y-62.3)) ** -1.0
 C** A = 3.5521E-4 R=2.23505E-4
 C** NOTE: Z COMPUTED FROM CENTERLINE OF BODY.
 C**

COMMON /BXXX/ X(IMXLL,JMXLL,KMXLL),Y(IMXLL,JMXLL,KMXLL),
 1 Z(IMXLL,JMXLL,KMXLL),P(IMXLL),Q(JMXLL),R(KMXLL)
 COMMON /AXXX/ IMAX,JMAX,KMAX,ILIMIT,JLIMIT,KLIMIT,ISOLN,
 1 KKK,XERRMX,YERRMX,ZERRMX,IXERI,IXERJ,IXERK,IYERI,IYERJ,
 2 IYERK,IZERI,IZERJ,IZERK,R1,R2,R3,R4,IERR,ITERMX,IPRT1,
 3 IDEL1,JDEL1,IPRT2,IDEI2,JDEL2,NPLT1,ITYPE,ISTN,SIZE1,
 4 SIZE2,LL,HED1(4),HED2(4),IPLSET,FILLXX(25)

C**
 C** COMPUTE YCL. TAN4 IS TANGENT OF 4-DEGREES.
 C**

TAN4 = .0699268119
 A = 0.00035521
 B = 0.000223505
 DO 50 I = 1,IMAX
 Z(I,1,1) = 0.0
 IF(X(I,1,1).GT.62.3) GO TO 20
 Y(I,1,1) = X(I,1,1) * TAN4
 GO TO 40
 20 CONTINUE
 Y(I,1,1) = -457.8350 + (463.3164*463.3164 -
 1 (X(I,1,1) - 94.56704)*(X(I,1,1) - 94.56704))**0.5
 40 CONTINUE
 50 CONTINUE

C**
 C** ON ALL I STATIONS X IS CONSTANT AND ON ALL
 C** K-STATIONS Z IS CONSTANT
 C**

DO 75 I = 1,IMAX
 DO 75 J = 1,JMAX
 DO 75 K = 1,KMAX
 X(I,J,K) = X(I,1,1)
 Z(I,J,K) = Z(1,1,K)
 75 CONTINUE

C**

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C**      ON J = JMAX Y = Y(1,JMAX,1)
C**
      DO 100 I = 1,IMAX
        DO 100 K = 1,KMAX
          Y(I,JMAX,K) = Y(1,JMAX,1)
100    CONTINUE
C**
C**      COMPUTE Y ON J = 1. UPTO X = 62.3 Y STAYS CONSTANT IN K
C**      DIRECTION. FOR X GREATER THAN 62.3 Y HAS TO BE COMPUTED.
C**
      DO 130 I = 1,IMAX
        DO 120 K = 2,KMAX
          IF(X(I,1,1).GT.62.3) GO TO 110
          Y(I,1,K) = Y(I,1,1)
          GO TO 115
110      CONTINUE
          RR = 1.0 / (A + B*(X(I,1,1) - 62.3))
          Y(I,1,K) = Y(I,1,1) - RR + (RR*RR - Z(I,1,K)
1          * Z(I,1,K)) ** 0.5
115    CONTINUE
120    CONTINUE
130    CONTINUE
C**
C**      COMPUTE Y FROM J = 2 THRU JMAX - 1. POINTS ARE
C**      DISTRIBUTED IN THE SAME RATIO AS ON I = 1,K=1 LINE.
C**
      J1 = JMAX - 1
      DO 150 I = 1,IMAX
        DO 150 J = 2,J1
          DO 150 K = 1,KMAX
            Y(I,J,K) = Y(I,1,K) + (Y(I,JMAX,K) - Y(I,1,K)) *
1            (Y(I,J,1) - Y(I,1,1)) / (Y(1,JMAX,1) - Y(1,1,1))
150    CONTINUE
C**
C**      INITIAL GUESS SPECIFIED. COMPUTE P,Q, AND R
C**
      I1 = IMAX - 1
      DO 200 I = 2,I1
        XU = X(I+1,1,1) - 2.0*X(I,1,1) + X(I-1,1,1)
        XU = 0.5 * (X(I+1,1,1) - X(I-1,1,1))
        P(I) = - XU / (XU*XU*XU)
200    CONTINUE
C**
      DO 250 J = 2,J1

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      YUU = Y(1,J+1,1) - 2.0*Y(1,J,1) + Y(1,J-1,1)
      YU  = 0.5 * (Y(1,J+1,1) - Y(1,J-1,1))
      Q(J) = - YUU / (YU+YU+YU)
250 CONTINUE
C**
      K1 = KMAX - 1
      DO 300 K = 2,K1
        ZUU = Z(1,1,K+1) - 2.0*Z(1,1,K) + Z(1,1,K-1)
        ZU  = 0.5 * (Z(1,1,K+1) - Z(1,1,K-1))
        R(K) = - ZUU / (ZU+ZU+ZU)
300 CONTINUE
C**
      RETURN
      END
      SUBROUTINE CALCOR
C**
C**      THIS SUBROUTINE COMPUTES Y-COORDINATE ONLY IN THE INNER GRID.
C**      X AND Z COORDINATES IN THE GRID ARE FIXED. FOR SIMPLICITY
C**      U SIGNIFIES XI, V - ETA, AND W - TAU. THUS XU SIGNIFIES
C**      DX/DXI. XUU = D2X/DXI2 AND SO ON.
C**      KKK = 0 SIGNIFIES UNCONVERGED SOLUTION.
C**
      COMMON /BXXX/ X(IMXLL,JMXLL,KMXLL),Y(IMXLL,JMXLL,KMXLL),
1      Z(IMXLL,JMXLL,KMXLL),P(IMXLL),Q(JMXLL),R(KMXLL)
      COMMON /AXXX/ IMAX,JMAX,KMAX,ILIMIT,JLIMIT,KLIMIT,ISOLN,
1      KKK,XERRMX,YERRMX,ZERRMX,IXERT,IXERJ,IXERK,IYERI,IYERJ,
2      IYERK,IZERI,IZERJ,IZERK,R1,R2,R3,R4,IERR,ITERMX,IPRT1,
3      IDEL1,JDEL1,IPRT2,IDEL2,JDEL2,NPLT1,ITYPE,ISTN,SIZE1,
4      SIZE2,LL,HED1(4),HED2(4),IPLSET,FILLXX(25)
C**
      ISOLN = 1
      KKK = 0
      IERFLG = 0
      I1 = IMAX - 1
      J1 = JMAX - 1
      K1 = KMAX - 1
      DO 600 IJK = 1,ITERMX
        LL = IJK
        YERRMX = 0.0
        DO 400 I = 2,I1
          DO 400 J = 2,J1
            DO 400 K = 2,K1
              YTEMP = Y(I,J,K)
              PPP = P(I)

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QQQ = Q(J)

RRR = R(K)

IP1 = I+1

IM1 = I-1

JP1 = J+1

JM1 = J-1

KP1 = K+1

KM1 = K-1

XU = (X(IP1,J,K) - X(IM1,J,K)) * 0.5

YU = (Y(IP1,J,K) - Y(IM1,J,K)) * 0.5

ZU = (Z(IP1,J,K) - Z(IM1,J,K)) * 0.5

XV = (X(I,JP1,K) - X(I,JM1,K)) * 0.5

YV = (Y(I,JP1,K) - Y(I,JM1,K)) * 0.5

ZV = (Z(I,JP1,K) - Z(I,JM1,K)) * 0.5

XW = (X(I,J,KP1) - X(I,J,KM1)) * 0.5

YW = (Y(I,J,KP1) - Y(I,J,KM1)) * 0.5

ZW = (Z(I,J,KP1) - Z(I,J,KM1)) * 0.5

YUU = Y(IP1,J,K) - 2.0*Y(I,J,K) + Y(IM1,J,K)

YVV = Y(I,JP1,K) - 2.0*Y(I,J,K) + Y(I,JM1,K)

YWW = Y(I,J,KP1) - 2.0*Y(I,J,K) + Y(I,J,KM1)

YUV = 0.25*(Y(IP1,JP1,K) - Y(IP1,JM1,K) - Y(IM1,JP1,K) +
Y(IM1,JM1,K))YUW = 0.25*(Y(IP1,J,KP1) - Y(IP1,J,KM1) - Y(IM1,J,KP1) +
Y(IM1,J,KM1))YVW = 0.25*(Y(I,JP1,KP1) - Y(I,JM1,KP1) - Y(I,JP1,KM1) +
Y(I,JM1,KM1))

C**

AJ = XU*(YV*ZW - ZV*YW) - XV*(YU*ZW - YW*ZU) +
XW*(YU*ZV - YV*ZU)CUU = (XV*YW - XW*YV)**2 + (XV*ZW - XW*ZV)**2 +
(YV*ZW - YW*ZV)**2CUV = (XU*YW - XW*YU)*(XV*YW - XW*YV) + (XU*ZW - XW*ZU)*
(XV*ZW - XW*ZV) + (YU*ZW - YW*ZU)*(YV*ZW - YW*ZV)CUW = (XU*YV - XV*YU)*(XV*YW - XW*YV) + (XU*ZV - XV*ZU)*
(XV*ZW - XW*ZV) + (YU*ZV - YV*ZU)*(YV*ZW - YW*ZV)CVV = (XU*YW - XW*YU)**2 + (XU*ZW - XW*ZU)**2 +
(YU*ZW - YW*ZU)**2CVW = (XU*YV - XV*YU)*(XU*YW - XW*YU) + (XU*ZV - XV*ZU)*
(XU*ZW - XW*ZU) + (YU*ZV - YV*ZU)*(YU*ZW - YW*ZU)CWW = (XU*YV - XV*YU)**2 + (XU*ZV - XV*ZU)**2 +
(YU*ZV - YV*ZU)**2

CF = 0.5 / (CUU + CVV + CWW)

YTEMP1 = CF*(CUU*(Y(I+1,J,K) + Y(I-1,J,K)) - 2.0*CUV*YUV
+ 2.0*CUW*YUW + CVV*(Y(I,J+1,K) + Y(I,J-1,K)))

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2      + CWW*(Y(I,J,K+1) + Y(I,J,K-1)) - 2.0*CVW*YVW +
3      (PPP*YU + QQQ*YV + RRR*YW) * (AJ*AJ))
      Y(I,J,K) = (1.0-R1) * YTEMP + R1*YTEMP1
C**
C**      COMPUTE MAX Y-ERROR
C**
      YERR = ABS(YTEMP - Y(I,J,K))
      IF(YERR.LE.YERRMX) GO TO 150
      YERRMX = YERR
      IYER1 = I
      IYERJ = J
      IYERK = K
150    CONTINUE
400    CONTINUE
C**
C**      CHECK IF ERROR NEEDS TO BE PRINTED.
C**
      IERFLG = IERFLG + 1
      IF(IERFLG.LT.IERR) GO TO 450
      WRITE(6,1000) LL,YERRMX,IYER1,IYERJ,IYERK
      IERFLG = 0
450    CONTINUE
C**
C**      CHECK FOR CONVERGENCE
C*
      IF(YERRMX.LT.R3) KKK = 1
      IF(YERRMX.LT.R3) GO TO 650
600    CONTINUE
C**
650    CONTINUE
C**
      RETURN
1000  FORMAT("0",5X,"ITERATION NO.,MAX Y-ERR, LOC  = ",I5,2X,E15.5,2X,
1      3I5)
C**
      END
      SUBROUTINE IPRTC
C**
C**      SUBROUTINE USED TO PRINT INITIAL, CONVERGED OR PARTIALLY
C**      CONVERGED SOLUTION. ALL PERTINENT PARAMETERS ARE PASSED
C**      THRU COMMON.
C**      ISOLN = 0 INDICATES INITIAL GUESS
C**      ISOLN = 1 AND KKK = 0 INDICATES PARTIALLY CONVERGED SOLN
C**      ISOLN = 1 AND KKK = 1 INDICATES CONVERGED SOLUTION.

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C**      COMMON /BXXX/ X(IMXLL,JMXLL,KMXLL),Y(IMXLL,JMXLL,KMXLL),
1        Z(IMXLL,JMXLL,KMXLL),P(IMXLL),Q(JMXLL),R(KMXLL)
      COMMON /AXXX/ IMAX,JMAX,KMAX,ILIMIT,JLIMIT,KLIMIT,ISOLN,
1        KKK,XERRMX,YERRMX,ZERRMX,IXERI,IXFRJ,IYERK,IYERI,IYERJ,
2        IYERK,IZERI,IZERJ,IZERK,R1,R2,R3,P4,IERR,ITERMX,IPRT1,
3        IDEL1,JDEL1,IPRT2,IDEL2,JDEL2,NPLT1,ITYPE,ISTN,SIZE1,
4        SIZE2,LL,HED1(4),HED2(4),IPLSET,FILLXX(25)

C**      IF(ISOLN.EQ.1) GO TO 10
      IPRTX = IPRT1
      IDELX = IDEL1
      JDELX = JDEL1
      GO TO 20
10 CONTINUE

C**      IPRTX = IPRT2
      IDELX = IDEL2
      JDELX = JDEL2
20 CONTINUE

C**      IF(IPRTX.EQ.0) GO TO 600

C**      WRITE HEADINGS
C**
C**      WRITE(6,1000) HED1
      WRITE(6,1010) HED2
      IF(ISOLN.EQ.0) WRITE(6,1020)
      IF(ISOLN.EQ.1.AND.KKK.EQ.0) WRITE(6,1030)
      IF(ISOLN.EQ.1.AND.KKK.EQ.1) WRITE(6,1040)
      WRITE(6,1050) IMAX,JMAX,KMAX
      IF(ISOLN.EQ.0) GO TO 50
      WRITE(6,1060) LL
      WRITE(6,1070) YERRMX,IYERI,IYERJ,IYERK
50 CONTINUE

C**      DO 300 I = 1,IMAX,IDELX
      DO 290 J = 1,JMAX,JDELX
      WRITE(6,1080) I,J
      WRITE(6,1090) ((X(I,J,K),Y(I,J,K),Z(I,J,K)),K=1,KMAX)
290 CONTINUE
300 CONTINUE
C**
600 CONTINUE

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RETURN
C**
C**      FORMAT STATEMENTS
C**
1000  FORMAT("1"/40X,4A10)
1010  FORMAT(/40X,4A10)
1020  FORMAT("0",49X,"*** INITIAL SOLUTION ***")
1030  FORMAT("0",41X,"*** PARTIALLY CONVERGED SOLUTION ***")
1040  FORMAT("0",48X,"*** CONVERGED SOLUTION ***")
1050  FORMAT("0",41X,"IMAX = ",I3,4X,"JMAX = ",I3,4X,"KMAX = ",I3)
1060  FORMAT("0",47X,"ITERATION PERFORMED = ",I5)
1070  FORMAT(" ",34X,"MAX Y-ERR = ",E14.6," AT LOC I,J,K = ",3I5)
1080  FORMAT(/5X,"I = ",I3," J = ",I3," (X,Y,Z)")
1090  FORMAT(5X,E11.5,3X,E11.5,3X,E11.5,3X,E11.5,3X,E11.5,3X,E11.5,
1      3X,E11.5,3X,E11.5,3X,E11.5)
C**
END
SUBROUTINE IPLTC
C**
C**      SUBROUTINE USED TO PLOT INITIAL CONVERGED OR PARTIAL
C**      CONVERGED SOLUTION. SEE COMMENTS UNDER IPRTC ROUTINE
C**
COMMON /BXXX/ X(IMXLL,JMXLL,KMXLL),Y(IMXLL,JMXLL,KMXLL),
1      Z(IMXLL,JMXLL,KMXLL),P(IMXLL),Q(JMXLL),R(KMXLL)
COMMON /AXXX/ IMAX,JMAX,KMAX,ILIMIT,JLIMIT,KLIMIT,ISOLN,
1      KKK,XERRMX,YERRMX,ZERRMX,IXERI,IXERJ,IXERK,IYERI,IYERJ,
2      IYERK,IZERI,IZERJ,IZERK,R1,R2,R3,R4,IERR,ITERMX,IPRT1,
3      IDEL1,JDEL1,IPRT2,IDEL2,JDEL2,NPLT1,ITYPE,ISTN,SIZE1,
4      SIZE2,LL,HED1(4),HED2(4),IPLSET,FILLXX(25)
C**
DIMENSION XDUM(75),YDUM(75),ZDUM(75),HED(4)
1
C**
C**      READ A CARD AND SEE IF PLOTS PLOTTED OR NOT
C**
READ(5,1000) NPLT1
IF(NPLT1.EQ.0) GO TO 900
C**
IF(IPLSET.EQ.1) GO TO 20
IPLSET = 1
CALL PSEUDO
CALL FONTS(1)
20 CONTINUE
C**

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C** READ NPLT1 CARDS AND PLOT

C** DO 500 KLM = 1,NPLT1
READ(5,1040) ITYPE,ISTN,SIZE1

C** PRINT HEADINGS.

C** CALL SCRIBE(0.3,1.5,0.15,0.5,HED1,90.,40,9)
CALL SCRIBE(0.55,1.5,0.15,0.5,HED2,90.,40,9)

C** IF(ISOLN.EQ.1) GO TO 50
HED(1) = 10H--- INITIA
HED(2) = 10HL GUESS --
HED(3) = 1H-
INUMC = 21
GO TO 100

C** 50 CONTINUE
IF(KKK.EQ.1) GO TO 75
HED(1) = 10H--- PARTIA
HED(2) = 10HLLY CONVER
HED(3) = 10HGED SOLUTI
HED(4) = 10HON ---
INUMC = 37
GO TO 100

C** 75 CONTINUE
HED(1) = 10H--- CONVER
HED(2) = 10HGED SOLUTI
HED(3) = 7HON ---
INUMC = 27

C** 100 CONTINUE
CALL SCRIBE(0.70,3.0,0.1,0.5,HED,90.0,INUMC,9)

C** WRITE ARRAY SIZES

C** ENCODE(40,1020,HED) IMAX,JMAX,KMAX
CALL SCRIBE(0.85,3.0,0.1,0.5,HED,90.0,36,9)
IF(ITYPE.EQ.2) GO TO 140
XX = X(ISTN,1,1)
ENCODE(40,1060,HED) ISTN,XX
GO TO 160

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140 CONTINUE
      ZZ = Z(1,1,ISTN)
      ENCODE(40,1080,HED) ISTN,ZZ
160 CONTINUE
      CALL SCRIBE(1.2,3.0,0.1,0.5,HED,90.0,38,9)
      CALL NFRAME

C**      START PLOT. IF ITYPE = 1 THEN Y-Z PLANE PLOTTED. IF ITYPE =2
C**      THEN X-Y PLANE PLOTTED.
C**
      IF(ITYPE.EQ.2) GO TO 300

C**      COMPUTE YMIN,YMAX, ZMIN,ZMAX
C**
      YMIN = 10000.0
      YMAX = -10000.0
      ZMIN = 10000.0
      ZMAX = -10000.0
      DO 180 J = 1,JMAX
        DO 180 K = 1,KMAX
          IF(Y(ISTN,J,K).LT.YMIN) YMIN = Y(ISTN,J,K)
          IF(Y(ISTN,J,K).GT.YMAX) YMAX = Y(ISTN,J,K)
          IF(Z(ISTN,J,K).GT.ZMAX) ZMAX = Z(ISTN,J,K)
          IF(Z(ISTN,J,K).LT.ZMIN) ZMIN = Z(ISTN,J,K)
180 CONTINUE
      SIZE2 = SIZE1 * (YMAX - YMIN) / (ZMAX - ZMIN)

C**      START PLOT. ETA LINES FIRST.
C**
      DO 200 J = 1,JMAX
        DO 190 K = 1,KMAX
          YDUM(K) = Y(ISTN,J,K)
          ZDUM(K) = Z(ISTN,J,K)
190 CONTINUE
      CALL INFOPLT(0,KMAX,ZDUM,1,YDUM,1,ZMIN,ZMAX,YMIN,YMAX,
1      1.0,0,HED,0,HED,0,SIZE1,SIZE2,0.0,2.0)
200 CONTINUE

C**      ZETA LINES.
C**
      KK = 0
      DO 230 K = 1,KMAX
        IF(K.EQ.KMAX) KK = 1
        DO 215 J = 1,JMAX

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      YDUM(J) = Y(ISTN,J,K)
      ZDUM(J) = Z(ISTN,J,K)
215  CONTINUE
      CALL INFOPLT(KK,JMAX,ZDUM,1,YDUM,1,ZMIN,ZMAX,YMIN,YMAX,
1      1.0,0,HED,0,HED,0,SIZE1,SIZE2,0.0,2.0)
230  CONTINUE
      GO TO 480

C**
C**
C**      X-Y PLANE IS TO BE PLOTTED.
C**

300  CONTINUE
      XMIN = 10000.0
      XMAX = -10000.0
      YMIN = 10000.0
      YMAX = -10000.0
      DO 320 I = 1,IMAX
        DO 320 J = 1,JMAX
          IF(X(I,J,ISTN).LT.XMIN) XMIN = X(I,J,ISTN)
          IF(X(I,J,ISTN).GT.XMAX) XMAX = X(I,J,ISTN)
          IF(Y(I,J,ISTN).LT.YMIN) YMIN = Y(I,J,ISTN)
          IF(Y(I,J,ISTN).GT.YMAX) YMAX = Y(I,J,ISTN)
320  CONTINUE
      SIZE2 = SIZE1 * (YMAX - YMIN) / (XMAX - XMIN)

C**
C**      ETA LINES
C**

      DO 350 J = 1,JMAX
        DO 340 I = 1,IMAX
          XDUM(I) = X(I,J,ISTN)
          YDUM(I) = Y(I,J,ISTN)
340  CONTINUE
      CALL INFOPLT(0,IMAX,XDUM,1,YDUM,1,XMIN,XMAX,YMIN,YMAX,
1      1.0,0,HED,0,HED,0,SIZE1,SIZE2,0.0,2.0)
350  CONTINUE

C**
C**      XI - LINES
C**

      KK = 0
      DO 400 I = 1,IMAX
        IF(I.EQ.IMAX) KK = 1
        DO 380 J = 1,JMAX
          XDUM(J) = X(I,J,ISTN)
          YDUM(J) = Y(I,J,ISTN)
```

```
AFTBDY 705
AFTBDY 706
AFTBDY 707
AFTBDY 708
AFTBDY 709
AFTBDY 710
AFTBDY 711
AFTBDY 712
AFTBDY 713
AFTBDY 714
AFTBDY 715
AFTBDY 716
AFTBDY 717
AFTBDY 718
AFTBDY 719
AFTBDY 720
AFTBDY 721
AFTBDY 722
AFTBDY 723
AFTBDY 724
AFTBDY 725
AFTBDY 726
AFTBDY 727
AFTBDY 728
AFTBDY 729
AFTBDY 730
AFTBDY 731
AFTBDY 732
AFTBDY 733
AFTBDY 734
AFTBDY 735
AFTBDY 736
AFTBDY 737
AFTBDY 738
AFTBDY 739
AFTBDY 740
AFTBDY 741
AFTBDY 742
AFTBDY 743
AFTBDY 744
AFTBDY 745
AFTBDY 746
AFTBDY 747
AFTBDY 748
```

```

380  CONTINUE
      CALL INFOPLT(KK,JMAX,XDUM,1,YDUM,1,XMIN,XMAX,YMIN,YMAX,
1      1.0,0,HED,0,HED,0,SIZE1,SIZE2,0.0,2.0)
400  CONTINUE
C**
480  CONTINUE
500  CONTINUE
C**
C**      ALL FUNCTIONS COMPLETE
C**
900  CONTINUE
      RETURN
1000 FORMAT(16I5)
1020 FORMAT(7HIMAX = ,I3,10H  JMAX = ,I3,10H  KMAX = ,I3)
1040 FORMAT(2I5,F10.0)
1060 FORMAT(17H-- Y-Z PLOT  I = ,I3,7H  X = ,E11.5)
1080 FORMAT(17H-- X-Y PLOT  K = ,I3,7H  Z = ,E11.5)
C**
      END

```

```

AFTBDY 749
AFTBDY 750
AFTBDY 751
AFTBDY 752
AFTBDY 753
AFTBDY 754
AFTBDY 755
AFTBDY 756
AFTBDY 757
AFTBDY 758
AFTBDY 759
AFTBDY 760
AFTBDY 761
AFTBDY 762
AFTBDY 763
AFTBDY 764
AFTBDY 765
AFTBDY 766
AFTBDY 767

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CORRECTION IDENTs ARE LISTED IN CHRONOLOGICAL ORDER OF INSERTION

AFTBDY

S ARE LISTED IN THE ORDER OF THEIR OCCURRENCE ON A NEW PROGRAM LIBRARY IF ONE IS CREATED BY THIS UPDATE

YANK\$\$\$ AFTBDY

B. Job Control Cards

A list of job control cards needed to run this program are included in the comment section of the main program AFTBDY.

C. Input Explanation

The instructions for input preparation are included in the comment section of the main program COORDC.

D. Sample Input

Sample input listing follows on the next page.

E. Sample Output

Sample output follows sample input.

JOB ORDER_____

PROGRAM NO. _____
CODED BY _____
DIVISION _____ SECTION _____

FORTRAN STATEMENT

[illegible]

PROGRAM NO. _____
CODED BY _____
DIVISION _____ SECTION _____

LANGLEY RESEARCH CENTER

FORTTRAN - DATA CODING FORM

DATE _____

PAGE _____

JOB ORDER _____

STATEMENT NUMBER	CONTINUATION	FORTTRAN STATEMENT
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 6		
		1 1 . 9 7 4 1 1 1
		1 2 . 9 7 0 3 2 2
		1 3 . 9 8 1 3 1 7
		1 5 . 0 0 0 0 0 0
		0 . 0 0 0 0 0 0
		0 . 3 0 1 4 6 3
		0 . 6 1 1 4 0 0
		0 . 9 3 7 4 6 3
		1 . 2 8 6 4 0 0
		1 . 6 6 4 0 6 3
		2 . 0 7 5 4 0 0
		2 . 5 2 4 4 6 3
		3 . 0 1 4 4 0 0
		3 . 5 4 7 4 6 3
		4 . 1 2 5 0 0 0
		4 . 7 4 7 4 6 3
		5 . 4 1 4 4 0 0
		6 . 1 2 4 4 6 3
		6 . 8 7 5 4 0 0
		7 . 6 6 4 0 6 3
		8 . 4 8 6 4 0 0
		9 . 3 3 7 4 6 3
		1 0 . 2 1 1 4 0 0
		1 1 . 1 0 1 4 6 3
		1 2 . 0 0 0 0 0 0

IMAX,JMAX,KMAX = 26 26 21

R1,R2,R3,R4,IERR,ITERMX = .90000E+00 .10000E-04 .50000E-05 .10000E-04 50 500

IPRT1,IOEL1,JOEL1,IPRT2,IOEL2,JOEL2 = 1 5 5 1 5 5

HED1 = AFTER BODY NUMBER 1

HED2 = TEST STARTED FEB 16, 1979

AETER BODY NUMBER 1

TEST STARTED FEB 16, 1979

*** INITIAL SOLUTION ***

IMAX = 26 JMAX = 26 KMAX = 21

I = 1 J = 1 (X,Y,Z)

0.	0.	0.	0.	0.	0.	.30146E+00	0.	0.	.61140E+00
0.	0.	.93746E+00	0.	0.	0.	.12864E+01	0.	0.	.16641E+01
0.	0.	.20754E+01	0.	0.	0.	.25245E+01	0.	0.	.30144E+01
0.	0.	.35475E+01	0.	0.	0.	.41250E+01	0.	0.	.47475E+01
0.	0.	.54144E+01	0.	0.	0.	.61245E+01	0.	0.	.68754E+01
0.	0.	.76641E+01	0.	0.	0.	.84864E+01	0.	0.	.93375E+01
0.	0.	.10211E+02	0.	0.	0.	.11101E+02	0.	0.	.12000E+02

I = 1 J = 6 (X,Y,Z)

0.	.10512E+01	0.	0.	.10512E+01	.30146E+00	0.	.10512E+01	.61140E+00
0.	.10512E+01	.93746E+00	0.	.10512E+01	.12864E+01	0.	.10512E+01	.16641E+01
0.	.10512E+01	.20754E+01	0.	.10512E+01	.25245E+01	0.	.10512E+01	.30144E+01
0.	.10512E+01	.35475E+01	0.	.10512E+01	.41250E+01	0.	.10512E+01	.47475E+01
0.	.10512E+01	.54144E+01	0.	.10512E+01	.61245E+01	0.	.10512E+01	.68754E+01
0.	.10512E+01	.76641E+01	0.	.10512E+01	.84864E+01	0.	.10512E+01	.93375E+01
0.	.10512E+01	.10211E+02	0.	.10512E+01	.11101E+02	0.	.10512E+01	.12000E+02

I = 1 J = 11 (X,Y,Z)

0.	.28752E+01	0.	0.	.28752E+01	.30146E+00	0.	.28752E+01	.61140E+00
0.	.28752E+01	.93746E+00	0.	.28752E+01	.12864E+01	0.	.28752E+01	.16641E+01
0.	.28752E+01	.20754E+01	0.	.28752E+01	.25245E+01	0.	.28752E+01	.30144E+01
0.	.28752E+01	.35475E+01	0.	.28752E+01	.41250E+01	0.	.28752E+01	.47475E+01
0.	.28752E+01	.54144E+01	0.	.28752E+01	.61245E+01	0.	.28752E+01	.68754E+01
0.	.28752E+01	.76641E+01	0.	.28752E+01	.84864E+01	0.	.28752E+01	.93375E+01
0.	.28752E+01	.10211E+02	0.	.28752E+01	.11101E+02	0.	.28752E+01	.12000E+02

I = 1 J = 16 (X,Y,Z)

0.	.58752E+01	0.	0.	.58752E+01	.30146E+00	0.	.58752E+01	.61140E+00
0.	.58752E+01	.93746E+00	0.	.58752E+01	.12864E+01	0.	.58752E+01	.16641E+01
0.	.58752E+01	.20754E+01	0.	.58752E+01	.25245E+01	0.	.58752E+01	.30144E+01
0.	.58752E+01	.35475E+01	0.	.58752E+01	.41250E+01	0.	.58752E+01	.47475E+01
0.	.58752E+01	.54144E+01	0.	.58752E+01	.61245E+01	0.	.58752E+01	.68754E+01
0.	.58752E+01	.76641E+01	0.	.58752E+01	.84864E+01	0.	.58752E+01	.93375E+01
0.	.58752E+01	.10211E+02	0.	.58752E+01	.11101E+02	0.	.58752E+01	.12000E+02

I = 1 J = 21 (X,Y,Z)

0.	.10051E+02	0.	0.	.10051E+02	.30146E+00	0.	.10051E+02	.61140E+00
0.	.10051E+02	.93746E+00	0.	.10051E+02	.12864E+01	0.	.10051E+02	.16641E+01
0.	.10051E+02	.20754E+01	0.	.10051E+02	.25245E+01	0.	.10051E+02	.30144E+01
0.	.10051E+02	.35475E+01	0.	.10051E+02	.41250E+01	0.	.10051E+02	.47475E+01
0.	.10051E+02	.54144E+01	0.	.10051E+02	.61245E+01	0.	.10051E+02	.68754E+01
0.	.10051E+02	.76641E+01	0.	.10051E+02	.84864E+01	0.	.10051E+02	.93375E+01
0.	.10051E+02	.10211E+02	0.	.10051E+02	.11101E+02	0.	.10051E+02	.12000E+02

I = 1 J = 26 (X,Y,Z)

0.	.15000E+02	0.	0.	.15000E+02	.30146E+00	0.	.15000E+02	.61140E+00
0.	.15000E+02	.93746E+00	0.	.15000E+02	.12864E+01	0.	.15000E+02	.16641E+01
0.	.15000E+02	.20754E+01	0.	.15000E+02	.25245E+01	0.	.15000E+02	.30144E+01
0.	.15000E+02	.35475E+01	0.	.15000E+02	.41250E+01	0.	.15000E+02	.47475E+01
0.	.15000E+02	.54144E+01	0.	.15000E+02	.61245E+01	0.	.15000E+02	.68754E+01
0.	.15000E+02	.76641E+01	0.	.15000E+02	.84864E+01	0.	.15000E+02	.93375E+01
0.	.15000E+02	.10211E+02	0.	.15000E+02	.11101E+02	0.	.15000E+02	.12000E+02

I = 6 J = 1 (X,Y,Z)

.18000E+02	.12587E+01	0.	.18000E+02	.12587E+01	.30146E+00	.18000E+02	.12587E+01	.61140E+00
.18000E+02	.12587E+01	.93746E+00	.18000E+02	.12587E+01	.12864E+01	.18000E+02	.12587E+01	.16641E+01
.18000E+02	.12587E+01	.20754E+01	.18000E+02	.12587E+01	.25245E+01	.18000E+02	.12587E+01	.30144E+01
.18000E+02	.12587E+01	.35475E+01	.18000E+02	.12587E+01	.41250E+01	.18000E+02	.12587E+01	.47475E+01
.18000E+02	.12587E+01	.54144E+01	.18000E+02	.12587E+01	.61245E+01	.18000E+02	.12587E+01	.68754E+01
.18000E+02	.12587E+01	.76641E+01	.18000E+02	.12587E+01	.84864E+01	.18000E+02	.12587E+01	.93375E+01
.18000E+02	.12587E+01	.10211E+02	.18000E+02	.12587E+01	.11101E+02	.18000E+02	.12587E+01	.12000E+02

I = 6 J = 6 (X,Y,Z)

.18000E+02	.22217E+01	0.	.18000E+02	.22217E+01	.30146E+00	.18000E+02	.22217E+01	.61140E+00
.18000E+02	.22217E+01	.93746E+00	.18000E+02	.22217E+01	.12864E+01	.18000E+02	.22217E+01	.16641E+01
.18000E+02	.22217E+01	.20754E+01	.18000E+02	.22217E+01	.25245E+01	.18000E+02	.22217E+01	.30144E+01
.18000E+02	.22217E+01	.35475E+01	.18000E+02	.22217E+01	.41250E+01	.18000E+02	.22217E+01	.47475E+01
.18000E+02	.22217E+01	.54144E+01	.18000E+02	.22217E+01	.61245E+01	.18000E+02	.22217E+01	.68754E+01
.18000E+02	.22217E+01	.76641E+01	.18000E+02	.22217E+01	.84864E+01	.18000E+02	.22217E+01	.93375E+01
.18000E+02	.22217E+01	.10211E+02	.18000E+02	.22217E+01	.11101E+02	.18000E+02	.22217E+01	.12000E+02

I = 6 J = 11 (X,Y,Z)

.18000E+02	.38926E+01	0.	.18000E+02	.38926E+01	.30146E+00	.18000E+02	.38926E+01	.61140E+00
.18000E+02	.38926E+01	.93746E+00	.18000E+02	.38926E+01	.12864E+01	.18000E+02	.38926E+01	.16641E+01
.18000E+02	.38926E+01	.20754E+01	.18000E+02	.38926E+01	.25245E+01	.18000E+02	.38926E+01	.30144E+01
.18000E+02	.38926E+01	.35475E+01	.18000E+02	.38926E+01	.41250E+01	.18000E+02	.38926E+01	.47475E+01
.18000E+02	.38926E+01	.54144E+01	.18000E+02	.38926E+01	.61245E+01	.18000E+02	.38926E+01	.68754E+01
.18000E+02	.38926E+01	.76641E+01	.18000E+02	.38926E+01	.84864E+01	.18000E+02	.38926E+01	.93375E+01

.18000E+02	.38926E+01	.10211E+02	.18000E+02	.38926E+01	.11101E+02	.18000E+02	.38926E+01	.12000E+02
------------	------------	------------	------------	------------	------------	------------	------------	------------

I = 6 J = 16 (X,Y,Z)								
.18000E+02	.66409E+01	0.	.18000E+02	.66409E+01	.30146E+00	.18000E+02	.66409E+01	.61140E+00
.18000E+02	.66409E+01	.93746E+00	.18000E+02	.66409E+01	.12864E+01	.18000E+02	.66409E+01	.16641E+01
.18000E+02	.66409E+01	.20754E+01	.18000E+02	.66409E+01	.25245E+01	.18000E+02	.66409E+01	.30144E+01
.18000E+02	.66409E+01	.35475E+01	.18000E+02	.66409E+01	.41250E+01	.18000E+02	.66409E+01	.47475E+01
.18000E+02	.66409E+01	.54144E+01	.18000E+02	.66409E+01	.61245E+01	.18000E+02	.66409E+01	.68754E+01
.18000E+02	.66409E+01	.76641E+01	.18000E+02	.66409E+01	.84864E+01	.18000E+02	.66409E+01	.93375E+01
.18000E+02	.66409E+01	.10211E+02	.18000E+02	.66409E+01	.11101E+02	.18000E+02	.66409E+01	.12000E+02

I = 6 J = 21 (X,Y,Z)								
.18000E+02	.10466E+02	0.	.18000E+02	.10466E+02	.30146E+00	.18000E+02	.10466E+02	.61140E+00
.18000E+02	.10466E+02	.93746E+00	.18000E+02	.10466E+02	.12864E+01	.18000E+02	.10466E+02	.16641E+01
.18000E+02	.10466E+02	.20754E+01	.18000E+02	.10466E+02	.25245E+01	.18000E+02	.10466E+02	.30144E+01
.18000E+02	.10466E+02	.35475E+01	.18000E+02	.10466E+02	.41250E+01	.18000E+02	.10466E+02	.47475E+01
.18000E+02	.10466E+02	.54144E+01	.18000E+02	.10466E+02	.61245E+01	.18000E+02	.10466E+02	.68754E+01
.18000E+02	.10466E+02	.76641E+01	.18000E+02	.10466E+02	.84864E+01	.18000E+02	.10466E+02	.93375E+01
.18000E+02	.10466E+02	.10211E+02	.18000E+02	.10466E+02	.11101E+02	.18000E+02	.10466E+02	.12000E+02

I = 6 J = 26 (X,Y,Z)								
.18000E+02	.15000E+02	0.	.18000E+02	.15000E+02	.30146E+00	.18000E+02	.15000E+02	.61140E+00
.18000E+02	.15000E+02	.93746E+00	.18000E+02	.15000E+02	.12864E+01	.18000E+02	.15000E+02	.16641E+01
.18000E+02	.15000E+02	.20754E+01	.18000E+02	.15000E+02	.25245E+01	.18000E+02	.15000E+02	.30144E+01
.18000E+02	.15000E+02	.35475E+01	.18000E+02	.15000E+02	.41250E+01	.18000E+02	.15000E+02	.47475E+01
.18000E+02	.15000E+02	.54144E+01	.18000E+02	.15000E+02	.61245E+01	.18000E+02	.15000E+02	.68754E+01
.18000E+02	.15000E+02	.76641E+01	.18000E+02	.15000E+02	.84864E+01	.18000E+02	.15000E+02	.93375E+01
.18000E+02	.15000E+02	.10211E+02	.18000E+02	.15000E+02	.11101E+02	.18000E+02	.15000E+02	.12000E+02

I = 11 J = 1 (X,Y,Z)								
.36000E+02	.25174E+01	0.	.36000E+02	.25174E+01	.30146E+00	.36000E+02	.25174E+01	.61140E+00
.36000E+02	.25174E+01	.93746E+00	.36000E+02	.25174E+01	.12864E+01	.36000E+02	.25174E+01	.16641E+01
.36000E+02	.25174E+01	.20754E+01	.36000E+02	.25174E+01	.25245E+01	.36000E+02	.25174E+01	.30144E+01
.36000E+02	.25174E+01	.35475E+01	.36000E+02	.25174E+01	.41250E+01	.36000E+02	.25174E+01	.47475E+01
.36000E+02	.25174E+01	.54144E+01	.36000E+02	.25174E+01	.61245E+01	.36000E+02	.25174E+01	.68754E+01
.36000E+02	.25174E+01	.76641E+01	.36000E+02	.25174E+01	.84864E+01	.36000E+02	.25174E+01	.93375E+01
.36000E+02	.25174E+01	.10211E+02	.36000E+02	.25174E+01	.11101E+02	.36000E+02	.25174E+01	.12000E+02

I = 11 J = 6 (X,Y,Z)								
.36000E+02	.33921E+01	0.	.36000E+02	.33921E+01	.30146E+00	.36000E+02	.33921E+01	.61140E+00
.36000E+02	.33921E+01	.93746E+00	.36000E+02	.33921E+01	.12864E+01	.36000E+02	.33921E+01	.16641E+01
.36000E+02	.33921E+01	.20754E+01	.36000E+02	.33921E+01	.25245E+01	.36000E+02	.33921E+01	.30144E+01
.36000E+02	.33921E+01	.35475E+01	.36000E+02	.33921E+01	.41250E+01	.36000E+02	.33921E+01	.47475E+01
.36000E+02	.33921E+01	.54144E+01	.36000E+02	.33921E+01	.61245E+01	.36000E+02	.33921E+01	.68754E+01

.54000E+02	.15000E+02	.35475E+01	.54000E+02	.15000E+02	.41250E+01	.54000E+02	.15000E+02	.47475E+01
.54000E+02	.15000E+02	.54144E+01	.54000E+02	.15000E+02	.61245E+01	.54000E+02	.15000E+02	.68754E+01
.54000E+02	.15000E+02	.76641E+01	.54000E+02	.15000E+02	.84864E+01	.54000E+02	.15000E+02	.93375E+01
.54000E+02	.15000E+02	.10211E+02	.54000E+02	.15000E+02	.11101E+02	.54000E+02	.15000E+02	.12000E+02

I = 21 J = 1 (X,Y,Z)

.72000E+02	.49315E+01	0.	.72000E+02	.49314E+01	.30146E+00	.72000E+02	.49310E+01	.61140E+00
.72000E+02	.49304E+01	.93746E+00	.72000E+02	.49294E+01	.12864E+01	.72000E+02	.49280E+01	.16641E+01
.72000E+02	.49260E+01	.20754E+01	.72000E+02	.49234E+01	.25245E+01	.72000E+02	.49200E+01	.30144E+01
.72000E+02	.49156E+01	.35475E+01	.72000E+02	.49100E+01	.41250E+01	.72000E+02	.49030E+01	.47475E+01
.72000E+02	.48945E+01	.54144E+01	.72000E+02	.48842E+01	.61245E+01	.72000E+02	.48718E+01	.68754E+01
.72000E+02	.48574E+01	.76641E+01	.72000E+02	.48406E+01	.84864E+01	.72000E+02	.48215E+01	.93375E+01
.72000E+02	.47999E+01	.10211E+02	.72000E+02	.47760E+01	.11101E+02	.72000E+02	.47498E+01	.12000E+02

I = 21 J = 6 (X,Y,Z)

.72000E+02	.56371E+01	0.	.72000E+02	.56370E+01	.30146E+00	.72000E+02	.56366E+01	.61140E+00
.72000E+02	.56361E+01	.93746E+00	.72000E+02	.56351E+01	.12864E+01	.72000E+02	.56338E+01	.16641E+01
.72000E+02	.56320E+01	.20754E+01	.72000E+02	.56296E+01	.25245E+01	.72000E+02	.56264E+01	.30144E+01
.72000E+02	.56223E+01	.35475E+01	.72000E+02	.56171E+01	.41250E+01	.72000E+02	.56106E+01	.47475E+01
.72000E+02	.56027E+01	.54144E+01	.72000E+02	.55931E+01	.61245E+01	.72000E+02	.55816E+01	.68754E+01
.72000E+02	.55682E+01	.76641E+01	.72000E+02	.55526E+01	.84864E+01	.72000E+02	.55348E+01	.93375E+01
.72000E+02	.55147E+01	.10211E+02	.72000E+02	.54925E+01	.11101E+02	.72000E+02	.54681E+01	.12000E+02

I = 21 J = 11 (X,Y,Z)

.72000E+02	.68614E+01	0.	.72000E+02	.68613E+01	.30146E+00	.72000E+02	.68610E+01	.61140E+00
.72000E+02	.68605E+01	.93746E+00	.72000E+02	.68597E+01	.12864E+01	.72000E+02	.68586E+01	.16641E+01
.72000E+02	.68570E+01	.20754E+01	.72000E+02	.68549E+01	.25245E+01	.72000E+02	.68521E+01	.30144E+01
.72000E+02	.68486E+01	.35475E+01	.72000E+02	.68441E+01	.41250E+01	.72000E+02	.68384E+01	.47475E+01
.72000E+02	.68315E+01	.54144E+01	.72000E+02	.68232E+01	.61245E+01	.72000E+02	.68132E+01	.68754E+01
.72000E+02	.68015E+01	.76641E+01	.72000E+02	.67880E+01	.84864E+01	.72000E+02	.67725E+01	.93375E+01
.72000E+02	.67551E+01	.10211E+02	.72000E+02	.67357E+01	.11101E+02	.72000E+02	.67145E+01	.12000E+02

I = 21 J = 16 (X,Y,Z)

.72000E+02	.88751E+01	0.	.72000E+02	.88750E+01	.30146E+00	.72000E+02	.88748E+01	.61140E+00
.72000E+02	.88744E+01	.93746E+00	.72000E+02	.88738E+01	.12864E+01	.72000E+02	.88730E+01	.16641E+01
.72000E+02	.88718E+01	.20754E+01	.72000E+02	.88702E+01	.25245E+01	.72000E+02	.88681E+01	.30144E+01
.72000E+02	.88655E+01	.35475E+01	.72000E+02	.88621E+01	.41250E+01	.72000E+02	.88578E+01	.47475E+01
.72000E+02	.88526E+01	.54144E+01	.72000E+02	.88463E+01	.61245E+01	.72000E+02	.88388E+01	.68754E+01
.72000E+02	.88300E+01	.76641E+01	.72000E+02	.88198E+01	.84864E+01	.72000E+02	.88082E+01	.93375E+01
.72000E+02	.87951E+01	.10211E+02	.72000E+02	.87805E+01	.11101E+02	.72000E+02	.87646E+01	.12000E+02

I = 21 J = 21 (X,Y,Z)

.72000E+02	.11678E+02	0.	.72000E+02	.11678E+02	.30146E+00	.72000E+02	.11678E+02	.61140E+00
.72000E+02	.11678E+02	.93746E+00	.72000E+02	.11678E+02	.12864E+01	.72000E+02	.11677E+02	.16641E+01

.72000E+02	.11676E+02	.20754E+01	.72000E+02	.11676E+02	.25245E+01	.72000E+02	.11674E+02	.30144E+01
.72000E+02	.11673E+02	.35475E+01	.72000E+02	.11671E+02	.41250E+01	.72000E+02	.11669E+02	.47475E+01
.72000E+02	.11666E+02	.54144E+01	.72000E+02	.11663E+02	.61245E+01	.72000E+02	.11659E+02	.68754E+01
.72000E+02	.11654E+02	.76641E+01	.72000E+02	.11648E+02	.84864E+01	.72000E+02	.11642E+02	.93375E+01
.72000E+02	.11635E+02	.10211E+02	.72000E+02	.11627E+02	.11101E+02	.72000E+02	.11618E+02	.12000E+02

I = 21 J = 26 (X,Y,Z)								
.72000E+02	.15000E+02	0.	.72000E+02	.15000E+02	.30146E+00	.72000E+02	.15000E+02	.61140E+00
.72000E+02	.15000E+02	.93746E+00	.72000E+02	.15000E+02	.12864E+01	.72000E+02	.15000E+02	.16641E+01
.72000E+02	.15000E+02	.20754E+01	.72000E+02	.15000E+02	.25245E+01	.72000E+02	.15000E+02	.30144E+01
.72000E+02	.15000E+02	.35475E+01	.72000E+02	.15000E+02	.41250E+01	.72000E+02	.15000E+02	.47475E+01
.72000E+02	.15000E+02	.54144E+01	.72000E+02	.15000E+02	.61245E+01	.72000E+02	.15000E+02	.68754E+01
.72000E+02	.15000E+02	.76641E+01	.72000E+02	.15000E+02	.84864E+01	.72000E+02	.15000E+02	.93375E+01
.72000E+02	.15000E+02	.10211E+02	.72000E+02	.15000E+02	.11101E+02	.72000E+02	.15000E+02	.12000E+02

I = 26 J = 1 (X,Y,Z)								
.90000E+02	.54589E+01	0.	.90000E+02	.54586E+01	.30146E+00	.90000E+02	.54577E+01	.61140E+00
.90000E+02	.54560E+01	.93746E+00	.90000E+02	.54535E+01	.12864E+01	.90000E+02	.54498E+01	.16641E+01
.90000E+02	.54448E+01	.20754E+01	.90000E+02	.54380E+01	.25245E+01	.90000E+02	.54291E+01	.30144E+01
.90000E+02	.54177E+01	.35475E+01	.90000E+02	.54032E+01	.41250E+01	.90000E+02	.53851E+01	.47475E+01
.90000E+02	.53629E+01	.54144E+01	.90000E+02	.53361E+01	.61245E+01	.90000E+02	.53041E+01	.68754E+01
.90000E+02	.52665E+01	.76641E+01	.90000E+02	.52230E+01	.84864E+01	.90000E+02	.51732E+01	.93375E+01
.90000E+02	.51172E+01	.10211E+02	.90000E+02	.50550E+01	.11101E+02	.90000E+02	.49868E+01	.12000E+02

I = 26 J = 6 (X,Y,Z)								
.90000E+02	.61275E+01	0.	.90000E+02	.61273E+01	.30146E+00	.90000E+02	.61264E+01	.61140E+00
.90000E+02	.61249E+01	.93746E+00	.90000E+02	.61225E+01	.12864E+01	.90000E+02	.61191E+01	.16641E+01
.90000E+02	.61144E+01	.20754E+01	.90000E+02	.61081E+01	.25245E+01	.90000E+02	.60999E+01	.30144E+01
.90000E+02	.60892E+01	.35475E+01	.90000E+02	.60757E+01	.41250E+01	.90000E+02	.60589E+01	.47475E+01
.90000E+02	.60383E+01	.54144E+01	.90000E+02	.60133E+01	.61245E+01	.90000E+02	.59836E+01	.68754E+01
.90000E+02	.59486E+01	.76641E+01	.90000E+02	.59082E+01	.84864E+01	.90000E+02	.58619E+01	.93375E+01
.90000E+02	.58098E+01	.10211E+02	.90000E+02	.57519E+01	.11101E+02	.90000E+02	.56886E+01	.12000E+02

I = 26 J = 11 (X,Y,Z)								
.90000E+02	.72877E+01	0.	.90000E+02	.72875E+01	.30146E+00	.90000E+02	.72867E+01	.61140E+00
.90000E+02	.72854E+01	.93746E+00	.90000E+02	.72834E+01	.12864E+01	.90000E+02	.72804E+01	.16641E+01
.90000E+02	.72763E+01	.20754E+01	.90000E+02	.72709E+01	.25245E+01	.90000E+02	.72637E+01	.30144E+01
.90000E+02	.72544E+01	.35475E+01	.90000E+02	.72427E+01	.41250E+01	.90000E+02	.72281E+01	.47475E+01
.90000E+02	.72101E+01	.54144E+01	.90000E+02	.71885E+01	.61245E+01	.90000E+02	.71626E+01	.68754E+01
.90000E+02	.71322E+01	.76641E+01	.90000E+02	.70970E+01	.84864E+01	.90000E+02	.70568E+01	.93375E+01
.90000E+02	.70115E+01	.10211E+02	.90000E+02	.69612E+01	.11101E+02	.90000E+02	.69062E+01	.12000E+02

I = 26 J = 16 (X,Y,Z)								
.90000E+02	.91960E+01	0.	.90000E+02	.91958E+01	.30146E+00	.90000E+02	.91952E+01	.61140E+00

.90000E+02	.91942E+01	.93746E+00	.90000E+02	.91927E+01	.12864E+01	.90000E+02	.91904E+01	.16641E+01
.90000E+02	.91874E+01	.20754E+01	.90000E+02	.91833E+01	.25245E+01	.90000E+02	.91779E+01	.30144E+01
.90000E+02	.91709E+01	.35475E+01	.90000E+02	.91621E+01	.41250E+01	.90000E+02	.91511E+01	.47475E+01
.90000E+02	.91376E+01	.54144E+01	.90000E+02	.91212E+01	.61245E+01	.90000E+02	.91018E+01	.68754E+01
.90000E+02	.90789E+01	.76641E+01	.90000E+02	.90524E+01	.84864E+01	.90000E+02	.90222E+01	.93375E+01
.90000E+02	.89881E+01	.10211E+02	.90000E+02	.89502E+01	.11101E+02	.90000E+02	.89088E+01	.12000E+02

I = 26 J = 21 (X,Y,Z)

.90000E+02	.11852E+02	0.	.90000E+02	.11852E+02	.30146E+00	.90000E+02	.11852E+02	.61140E+00
.90000E+02	.11851E+02	.93746E+00	.90000E+02	.11850E+02	.12864E+01	.90000E+02	.11849E+02	.16641E+01
.90000E+02	.11848E+02	.20754E+01	.90000E+02	.11845E+02	.25245E+01	.90000E+02	.11842E+02	.30144E+01
.90000E+02	.11839E+02	.35475E+01	.90000E+02	.11834E+02	.41250E+01	.90000E+02	.11828E+02	.47475E+01
.90000E+02	.11821E+02	.54144E+01	.90000E+02	.11812E+02	.61245E+01	.90000E+02	.11801E+02	.68754E+01
.90000E+02	.11789E+02	.76641E+01	.90000E+02	.11774E+02	.84864E+01	.90000E+02	.11758E+02	.93375E+01
.90000E+02	.11739E+02	.10211E+02	.90000E+02	.11719E+02	.11101E+02	.90000E+02	.11696E+02	.12000E+02

I = 26 J = 26 (X,Y,Z)

.90000E+02	.15000E+02	0.	.90000E+02	.15000E+02	.30146E+00	.90000E+02	.15000E+02	.61140E+00
.90000E+02	.15000E+02	.93746E+00	.90000E+02	.15000E+02	.12864E+01	.90000E+02	.15000E+02	.16641E+01
.90000E+02	.15000E+02	.20754E+01	.90000E+02	.15000E+02	.25245E+01	.90000E+02	.15000E+02	.30144E+01
.90000E+02	.15000E+02	.35475E+01	.90000E+02	.15000E+02	.41250E+01	.90000E+02	.15000E+02	.47475E+01
.90000E+02	.15000E+02	.54144E+01	.90000E+02	.15000E+02	.61245E+01	.90000E+02	.15000E+02	.68754E+01
.90000E+02	.15000E+02	.76641E+01	.90000E+02	.15000E+02	.84864E+01	.90000E+02	.15000E+02	.93375E+01
.90000E+02	.15000E+02	.10211E+02	.90000E+02	.15000E+02	.11101E+02	.90000E+02	.15000E+02	.12000E+02

ITERATION NO., MAX Y-ERR, LOC = 50 .53452E-02 23 15 13

ITERATION NO., MAX Y-ERR, LOC = 100 .18832E-02 22 17 12

ITERATION NO., MAX Y-ERR, LOC = 150 .62140E-03 22 17 12

ITERATION NO., MAX Y-ERR, LOC = 200 .19682E-03 22 17 12

ITERATION NO., MAX Y-ERR, LOC = 250 .61322E-04 22 17 12

ITERATION NO., MAX Y-ERR, LOC = 300 .18962E-04 22 17 12

ITERATION NO., MAX Y-ERR, LOC = 350 .58633E-05 21 17 12

AFTER BODY NUMBER 1

TEST STARTED FEB. 16, 1979

*** CONVERGED SOLUTION ***

IMAX = 26 JMAX = 26 KMAX = 21

ITERATION PERFORMED = 357

MAX Y-ERR = .497551E-05 AT LOC I, J, K = 21 17 12

I = 1 J = 1 (X, Y, Z)

0.	0.	0.	0.	0.	.30146E+00	0.	0.	.61140E+00
0.	0.	.93746E+00	0.	0.	.12864E+01	0.	0.	.16641E+01
0.	0.	.20754E+01	0.	0.	.25245E+01	0.	0.	.30144E+01
0.	0.	.35475E+01	0.	0.	.41250E+01	0.	0.	.47475E+01
0.	0.	.54144E+01	0.	0.	.61245E+01	0.	0.	.68754E+01
0.	0.	.76641E+01	0.	0.	.84864E+01	0.	0.	.93375E+01
0.	0.	.10211E+02	0.	0.	.11101E+02	0.	0.	.12000E+02

I = 1 J = 6 (X, Y, Z)

0.	.10512E+01	0.	0.	.10512E+01	.30146E+00	0.	.10512E+01	.61140E+00
0.	.10512E+01	.93746E+00	0.	.10512E+01	.12864E+01	0.	.10512E+01	.16641E+01
0.	.10512E+01	.20754E+01	0.	.10512E+01	.25245E+01	0.	.10512E+01	.30144E+01
0.	.10512E+01	.35475E+01	0.	.10512E+01	.41250E+01	0.	.10512E+01	.47475E+01
0.	.10512E+01	.54144E+01	0.	.10512E+01	.61245E+01	0.	.10512E+01	.68754E+01
0.	.10512E+01	.76641E+01	0.	.10512E+01	.84864E+01	0.	.10512E+01	.93375E+01
0.	.10512E+01	.10211E+02	0.	.10512E+01	.11101E+02	0.	.10512E+01	.12000E+02

I = 1 J = 11 (X, Y, Z)

0.	.28752E+01	0.	0.	.28752E+01	.30146E+00	0.	.28752E+01	.61140E+00
0.	.28752E+01	.93746E+00	0.	.28752E+01	.12864E+01	0.	.28752E+01	.16641E+01
0.	.28752E+01	.20754E+01	0.	.28752E+01	.25245E+01	0.	.28752E+01	.30144E+01
0.	.28752E+01	.35475E+01	0.	.28752E+01	.41250E+01	0.	.28752E+01	.47475E+01
0.	.28752E+01	.54144E+01	0.	.28752E+01	.61245E+01	0.	.28752E+01	.68754E+01
0.	.28752E+01	.76641E+01	0.	.28752E+01	.84864E+01	0.	.28752E+01	.93375E+01
0.	.28752E+01	.10211E+02	0.	.28752E+01	.11101E+02	0.	.28752E+01	.12000E+02

I = 1 J = 16 (X, Y, Z)

0.	.58752E+01	0.	0.	.58752E+01	.30146E+00	0.	.58752E+01	.61140E+00
0.	.58752E+01	.93746E+00	0.	.58752E+01	.12864E+01	0.	.58752E+01	.16641E+01
0.	.58752E+01	.20754E+01	0.	.58752E+01	.25245E+01	0.	.58752E+01	.30144E+01
0.	.58752E+01	.35475E+01	0.	.58752E+01	.41250E+01	0.	.58752E+01	.47475E+01

0.	.58752E+01	.54144E+01	0.	.58752E+01	.61245E+01	0.	.58752E+01	.68754E+01
0.	.58752E+01	.76641E+01	0.	.58752E+01	.84864E+01	0.	.58752E+01	.93375E+01
0.	.58752E+01	.10211E+02	0.	.58752E+01	.11101E+02	0.	.58752E+01	.12000E+02

I = 1 J = 21 (X,Y,Z)

0.	.10051E+02	0.	0.	.10051E+02	.30146E+00	0.	.10051E+02	.61140E+00
0.	.10051E+02	.93746E+00	0.	.10051E+02	.12864E+01	0.	.10051E+02	.16641E+01
0.	.10051E+02	.20754E+01	0.	.10051E+02	.25245E+01	0.	.10051E+02	.30144E+01
0.	.10051E+02	.35475E+01	0.	.10051E+02	.41250E+01	0.	.10051E+02	.47475E+01
0.	.10051E+02	.54144E+01	0.	.10051E+02	.61245E+01	0.	.10051E+02	.68754E+01
0.	.10051E+02	.76641E+01	0.	.10051E+02	.84864E+01	0.	.10051E+02	.93375E+01
0.	.10051E+02	.10211E+02	0.	.10051E+02	.11101E+02	0.	.10051E+02	.12000E+02

I = 1 J = 26 (X,Y,Z)

0.	.15000E+02	0.	0.	.15000E+02	.30146E+00	0.	.15000E+02	.61140E+00
0.	.15000E+02	.93746E+00	0.	.15000E+02	.12864E+01	0.	.15000E+02	.16641E+01
0.	.15000E+02	.20754E+01	0.	.15000E+02	.25245E+01	0.	.15000E+02	.30144E+01
0.	.15000E+02	.35475E+01	0.	.15000E+02	.41250E+01	0.	.15000E+02	.47475E+01
0.	.15000E+02	.54144E+01	0.	.15000E+02	.61245E+01	0.	.15000E+02	.68754E+01
0.	.15000E+02	.76641E+01	0.	.15000E+02	.84864E+01	0.	.15000E+02	.93375E+01
0.	.15000E+02	.10211E+02	0.	.15000E+02	.11101E+02	0.	.15000E+02	.12000E+02

I = 6 J = 1 (X,Y,Z)

.18000E+02	.12587E+01	0.	.18000E+02	.12587E+01	.30146E+00	.18000E+02	.12587E+01	.61140E+00
.18000E+02	.12587E+01	.93746E+00	.18000E+02	.12587E+01	.12864E+01	.18000E+02	.12587E+01	.16641E+01
.18000E+02	.12587E+01	.20754E+01	.18000E+02	.12587E+01	.25245E+01	.18000E+02	.12587E+01	.30144E+01
.18000E+02	.12587E+01	.35475E+01	.18000E+02	.12587E+01	.41250E+01	.18000E+02	.12587E+01	.47475E+01
.18000E+02	.12587E+01	.54144E+01	.18000E+02	.12587E+01	.61245E+01	.18000E+02	.12587E+01	.68754E+01
.18000E+02	.12587E+01	.76641E+01	.18000E+02	.12587E+01	.84864E+01	.18000E+02	.12587E+01	.93375E+01
.18000E+02	.12587E+01	.10211E+02	.18000E+02	.12587E+01	.11101E+02	.18000E+02	.12587E+01	.12000E+02

I = 6 J = 6 (X,Y,Z)

.18000E+02	.22217E+01	0.	.18000E+02	.22403E+01	.30146E+00	.18000E+02	.22542E+01	.61140E+00
.18000E+02	.22649E+01	.93746E+00	.18000E+02	.22732E+01	.12864E+01	.18000E+02	.22798E+01	.16641E+01
.18000E+02	.22849E+01	.20754E+01	.18000E+02	.22890E+01	.25245E+01	.18000E+02	.22922E+01	.30144E+01
.18000E+02	.22945E+01	.35475E+01	.18000E+02	.22963E+01	.41250E+01	.18000E+02	.22975E+01	.47475E+01
.18000E+02	.22982E+01	.54144E+01	.18000E+02	.22983E+01	.61245E+01	.18000E+02	.22979E+01	.68754E+01
.18000E+02	.22967E+01	.76641E+01	.18000E+02	.22942E+01	.84864E+01	.18000E+02	.22896E+01	.93375E+01
.18000E+02	.22809E+01	.10211E+02	.18000E+02	.22629E+01	.11101E+02	.18000E+02	.22217E+01	.12000E+02

I = 6 J = 11 (X,Y,Z)

.18000E+02	.38926E+01	0.	.18000E+02	.39181E+01	.30146E+00	.18000E+02	.39408E+01	.61140E+00
.18000E+02	.39612E+01	.93746E+00	.18000E+02	.39796E+01	.12864E+01	.18000E+02	.39961E+01	.16641E+01
.18000E+02	.40107E+01	.20754E+01	.18000E+02	.40235E+01	.25245E+01	.18000E+02	.40342E+01	.30144E+01

.18000E+02	.40431E+01	.35475E+01	.18000E+02	.40499E+01	.41250E+01	.18000E+02	.40549E+01	.47475E+01
.18000E+02	.40577E+01	.54144E+01	.18000E+02	.40584E+01	.61245E+01	.18000E+02	.40566E+01	.68754E+01
.18000E+02	.40515E+01	.76641E+01	.18000E+02	.40421E+01	.84864E+01	.18000E+02	.40261E+01	.93375E+01
.18000E+02	.40001E+01	.10211E+02	.18000E+02	.39584E+01	.11101E+02	.18000E+02	.38926E+01	.12000E+02

I = 6 J = 16 (X,Y,Z)

.18000E+02	.66409E+01	0.	.18000E+02	.66632E+01	.30146E+00	.18000E+02	.66845E+01	.61140E+00
.18000E+02	.67050E+01	.93746E+00	.18000E+02	.67249E+01	.12864E+01	.18000E+02	.67443E+01	.16641E+01
.18000E+02	.67628E+01	.20754E+01	.18000E+02	.67803E+01	.25245E+01	.18000E+02	.67962E+01	.30144E+01
.18000E+02	.68103E+01	.35475E+01	.18000E+02	.68219E+01	.41250E+01	.18000E+02	.68307E+01	.47475E+01
.18000E+02	.68361E+01	.54144E+01	.18000E+02	.68375E+01	.61245E+01	.18000E+02	.68341E+01	.68754E+01
.18000E+02	.68251E+01	.76641E+01	.18000E+02	.68091E+01	.84864E+01	.18000E+02	.67847E+01	.93375E+01
.18000E+02	.67499E+01	.10211E+02	.18000E+02	.67025E+01	.11101E+02	.18000E+02	.66409E+01	.12000E+02

I = 6 J = 21 (X,Y,Z)

.18000E+02	.10466E+02	0.	.18000E+02	.10479E+02	.30146E+00	.18000E+02	.10492E+02	.61140E+00
.18000E+02	.10504E+02	.93746E+00	.18000E+02	.10516E+02	.12864E+01	.18000E+02	.10528E+02	.16641E+01
.18000E+02	.10540E+02	.20754E+01	.18000E+02	.10552E+02	.25245E+01	.18000E+02	.10563E+02	.30144E+01
.18000E+02	.10573E+02	.35475E+01	.18000E+02	.10581E+02	.41250E+01	.18000E+02	.10588E+02	.47475E+01
.18000E+02	.10592E+02	.54144E+01	.18000E+02	.10593E+02	.61245E+01	.18000E+02	.10591E+02	.68754E+01
.18000E+02	.10584E+02	.76641E+01	.18000E+02	.10572E+02	.84864E+01	.18000E+02	.10555E+02	.93375E+01
.18000E+02	.10532E+02	.10211E+02	.18000E+02	.10503E+02	.11101E+02	.18000E+02	.10466E+02	.12000E+02

I = 6 J = 26 (X,Y,Z)

.18000E+02	.15000E+02	0.	.18000E+02	.15000E+02	.30146E+00	.18000E+02	.15000E+02	.61140E+00
.18000E+02	.15000E+02	.93746E+00	.18000E+02	.15000E+02	.12864E+01	.18000E+02	.15000E+02	.16641E+01
.18000E+02	.15000E+02	.20754E+01	.18000E+02	.15000E+02	.25245E+01	.18000E+02	.15000E+02	.30144E+01
.18000E+02	.15000E+02	.35475E+01	.18000E+02	.15000E+02	.41250E+01	.18000E+02	.15000E+02	.47475E+01
.18000E+02	.15000E+02	.54144E+01	.18000E+02	.15000E+02	.61245E+01	.18000E+02	.15000E+02	.68754E+01
.18000E+02	.15000E+02	.76641E+01	.18000E+02	.15000E+02	.84864E+01	.18000E+02	.15000E+02	.93375E+01
.18000E+02	.15000E+02	.10211E+02	.18000E+02	.15000E+02	.11101E+02	.18000E+02	.15000E+02	.12000E+02

I = 11 J = 1 (X,Y,Z)

.36000E+02	.25174E+01	0.	.36000E+02	.25174E+01	.30146E+00	.36000E+02	.25174E+01	.61140E+00
.36000E+02	.25174E+01	.93746E+00	.36000E+02	.25174E+01	.12864E+01	.36000E+02	.25174E+01	.16641E+01
.36000E+02	.25174E+01	.20754E+01	.36000E+02	.25174E+01	.25245E+01	.36000E+02	.25174E+01	.30144E+01
.36000E+02	.25174E+01	.35475E+01	.36000E+02	.25174E+01	.41250E+01	.36000E+02	.25174E+01	.47475E+01
.36000E+02	.25174E+01	.54144E+01	.36000E+02	.25174E+01	.61245E+01	.36000E+02	.25174E+01	.68754E+01
.36000E+02	.25174E+01	.76641E+01	.36000E+02	.25174E+01	.84864E+01	.36000E+02	.25174E+01	.93375E+01
.36000E+02	.25174E+01	.10211E+02	.36000E+02	.25174E+01	.11101E+02	.36000E+02	.25174E+01	.12000E+02

I = 11 J = 6 (X,Y,Z)

.36000E+02	.33921E+01	0.	.36000E+02	.34278E+01	.30146E+00	.36000E+02	.34544E+01	.61140E+00
.36000E+02	.34749E+01	.93746E+00	.36000E+02	.34910E+01	.12864E+01	.36000E+02	.35038E+01	.16641E+01

.36000E+02	.35139E+01	.20754E+01	.36000E+02	.35219E+01	.25245E+01	.36000E+02	.35282E+01	.30144E+01
.36000E+02	.35329E+01	.35475E+01	.36000E+02	.35364E+01	.41250E+01	.36000E+02	.35388E+01	.47475E+01
.36000E+02	.35402E+01	.54144E+01	.36000E+02	.35405E+01	.61245E+01	.36000E+02	.35396E+01	.68754E+01
.36000E+02	.35371E+01	.76641E+01	.36000E+02	.35322E+01	.84864E+01	.36000E+02	.35232E+01	.93375E+01
.36000E+02	.35060E+01	.10211E+02	.36000E+02	.34711E+01	.11101E+02	.36000E+02	.33921E+01	.12000E+02

I = 11 J = 11 (X,Y,Z)

.36000E+02	.49100E+01	0.	.36000E+02	.49597E+01	.30146E+00	.36000E+02	.50034E+01	.61140E+00
.36000E+02	.50424E+01	.93746E+00	.36000E+02	.50774E+01	.12864E+01	.36000E+02	.51087E+01	.16641E+01
.36000E+02	.51364E+01	.20754E+01	.36000E+02	.51604E+01	.25245E+01	.36000E+02	.51808E+01	.30144E+01
.36000E+02	.51975E+01	.35475E+01	.36000E+02	.52106E+01	.41250E+01	.36000E+02	.52199E+01	.47475E+01
.36000E+02	.52253E+01	.54144E+01	.36000E+02	.52266E+01	.61245E+01	.36000E+02	.52231E+01	.68754E+01
.36000E+02	.52136E+01	.76641E+01	.36000E+02	.51956E+01	.84864E+01	.36000E+02	.51654E+01	.93375E+01
.36000E+02	.51163E+01	.10211E+02	.36000E+02	.50370E+01	.11101E+02	.36000E+02	.49100E+01	.12000E+02

I = 11 J = 16 (X,Y,Z)

.36000E+02	.74066E+01	0.	.36000E+02	.74508E+01	.30146E+00	.36000E+02	.74924E+01	.61140E+00
.36000E+02	.75322E+01	.93746E+00	.36000E+02	.75705E+01	.12864E+01	.36000E+02	.76073E+01	.16641E+01
.36000E+02	.76424E+01	.20754E+01	.36000E+02	.76751E+01	.25245E+01	.36000E+02	.77048E+01	.30144E+01
.36000E+02	.77308E+01	.35475E+01	.36000E+02	.77523E+01	.41250E+01	.36000E+02	.77683E+01	.47475E+01
.36000E+02	.77781E+01	.54144E+01	.36000E+02	.77806E+01	.61245E+01	.36000E+02	.77745E+01	.68754E+01
.36000E+02	.77579E+01	.76641E+01	.36000E+02	.77286E+01	.84864E+01	.36000E+02	.76833E+01	.93375E+01
.36000E+02	.76178E+01	.10211E+02	.36000E+02	.75273E+01	.11101E+02	.36000E+02	.74066E+01	.12000E+02

I = 11 J = 21 (X,Y,Z)

.36000E+02	.10882E+02	0.	.36000E+02	.10907E+02	.30146E+00	.36000E+02	.10932E+02	.61140E+00
.36000E+02	.10956E+02	.93746E+00	.36000E+02	.10980E+02	.12864E+01	.36000E+02	.11004E+02	.16641E+01
.36000E+02	.11027E+02	.20754E+01	.36000E+02	.11049E+02	.25245E+01	.36000E+02	.11070E+02	.30144E+01
.36000E+02	.11089E+02	.35475E+01	.36000E+02	.11105E+02	.41250E+01	.36000E+02	.11117E+02	.47475E+01
.36000E+02	.11124E+02	.54144E+01	.36000E+02	.11126E+02	.61245E+01	.36000E+02	.11122E+02	.68754E+01
.36000E+02	.11109E+02	.76641E+01	.36000E+02	.11087E+02	.84864E+01	.36000E+02	.11055E+02	.93375E+01
.36000E+02	.11011E+02	.10211E+02	.36000E+02	.10954E+02	.11101E+02	.36000E+02	.10882E+02	.12000E+02

I = 11 J = 26 (X,Y,Z)

.36000E+02	.15000E+02	0.	.36000E+02	.15000E+02	.30146E+00	.36000E+02	.15000E+02	.61140E+00
.36000E+02	.15000E+02	.93746E+00	.36000E+02	.15000E+02	.12864E+01	.36000E+02	.15000E+02	.16641E+01
.36000E+02	.15000E+02	.20754E+01	.36000E+02	.15000E+02	.25245E+01	.36000E+02	.15000E+02	.30144E+01
.36000E+02	.15000E+02	.35475E+01	.36000E+02	.15000E+02	.41250E+01	.36000E+02	.15000E+02	.47475E+01
.36000E+02	.15000E+02	.54144E+01	.36000E+02	.15000E+02	.61245E+01	.36000E+02	.15000E+02	.68754E+01
.36000E+02	.15000E+02	.76641E+01	.36000E+02	.15000E+02	.84864E+01	.36000E+02	.15000E+02	.93375E+01
.36000E+02	.15000E+02	.10211E+02	.36000E+02	.15000E+02	.11101E+02	.36000E+02	.15000E+02	.12000E+02

I = 16 J = 1 (X,Y,Z)

.54000E+02	.37760E+01	0.	.54000E+02	.37760E+01	.30146E+00	.54000E+02	.37760E+01	.61140E+00
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.54000E+02	.37760E+01	.93746E+00	.54000E+02	.37760E+01	.12864E+01	.54000E+02	.37760E+01	.16641E+01
.54000E+02	.37760E+01	.20754E+01	.54000E+02	.37760E+01	.25245E+01	.54000E+02	.37760E+01	.30144E+01
.54000E+02	.37760E+01	.35475E+01	.54000E+02	.37760E+01	.41250E+01	.54000E+02	.37760E+01	.47475E+01
.54000E+02	.37760E+01	.54144E+01	.54000E+02	.37760E+01	.61245E+01	.54000E+02	.37760E+01	.68754E+01
.54000E+02	.37760E+01	.76641E+01	.54000E+02	.37760E+01	.84864E+01	.54000E+02	.37760E+01	.93375E+01
.54000E+02	.37760E+01	.10211E+02	.54000E+02	.37760E+01	.11101E+02	.54000E+02	.37760E+01	.12000E+02

I = 16 J = 6 (X,Y,Z)

.54000E+02	.45626E+01	0.	.54000E+02	.46143E+01	.30146E+00	.54000E+02	.46528E+01	.61140E+00
.54000E+02	.46824E+01	.93746E+00	.54000E+02	.47059E+01	.12864E+01	.54000E+02	.47246E+01	.16641E+01
.54000E+02	.47395E+01	.20754E+01	.54000E+02	.47514E+01	.25245E+01	.54000E+02	.47607E+01	.30144E+01
.54000E+02	.47678E+01	.35475E+01	.54000E+02	.47730E+01	.41250E+01	.54000E+02	.47766E+01	.47475E+01
.54000E+02	.47787E+01	.54144E+01	.54000E+02	.47791E+01	.61245E+01	.54000E+02	.47778E+01	.68754E+01
.54000E+02	.47741E+01	.76641E+01	.54000E+02	.47668E+01	.84864E+01	.54000E+02	.47532E+01	.93375E+01
.54000E+02	.47278E+01	.10211E+02	.54000E+02	.46767E+01	.11101E+02	.54000E+02	.45626E+01	.12000E+02

I = 16 J = 11 (X,Y,Z)

.54000E+02	.59275E+01	0.	.54000E+02	.60006E+01	.30146E+00	.54000E+02	.60643E+01	.61140E+00
.54000E+02	.61206E+01	.93746E+00	.54000E+02	.61707E+01	.12864E+01	.54000E+02	.62154E+01	.16641E+01
.54000E+02	.62548E+01	.20754E+01	.54000E+02	.62889E+01	.25245E+01	.54000E+02	.63178E+01	.30144E+01
.54000E+02	.63415E+01	.35475E+01	.54000E+02	.63599E+01	.41250E+01	.54000E+02	.63731E+01	.47475E+01
.54000E+02	.63809E+01	.54144E+01	.54000E+02	.63827E+01	.61245E+01	.54000E+02	.63777E+01	.68754E+01
.54000E+02	.63641E+01	.76641E+01	.54000E+02	.63387E+01	.84864E+01	.54000E+02	.62958E+01	.93375E+01
.54000E+02	.62259E+01	.10211E+02	.54000E+02	.61125E+01	.11101E+02	.54000E+02	.59275E+01	.12000E+02

I = 16 J = 16 (X,Y,Z)

.54000E+02	.81722E+01	0.	.54000E+02	.82384E+01	.30146E+00	.54000E+02	.82999E+01	.61140E+00
.54000E+02	.83581E+01	.93746E+00	.54000E+02	.84136E+01	.12864E+01	.54000E+02	.84664E+01	.16641E+01
.54000E+02	.85161E+01	.20754E+01	.54000E+02	.85621E+01	.25245E+01	.54000E+02	.86035E+01	.30144E+01
.54000E+02	.86394E+01	.35475E+01	.54000E+02	.86688E+01	.41250E+01	.54000E+02	.86906E+01	.47475E+01
.54000E+02	.87039E+01	.54144E+01	.54000E+02	.87072E+01	.61245E+01	.54000E+02	.86989E+01	.68754E+01
.54000E+02	.86763E+01	.76641E+01	.54000E+02	.86361E+01	.84864E+01	.54000E+02	.85732E+01	.93375E+01
.54000E+02	.84810E+01	.10211E+02	.54000E+02	.83508E+01	.11101E+02	.54000E+02	.81722E+01	.12000E+02

I = 16 J = 21 (X,Y,Z)

.54000E+02	.11297E+02	0.	.54000E+02	.11336E+02	.30146E+00	.54000E+02	.11373E+02	.61140E+00
.54000E+02	.11409E+02	.93746E+00	.54000E+02	.11445E+02	.12864E+01	.54000E+02	.11479E+02	.16641E+01
.54000E+02	.11512E+02	.20754E+01	.54000E+02	.11544E+02	.25245E+01	.54000E+02	.11573E+02	.30144E+01
.54000E+02	.11599E+02	.35475E+01	.54000E+02	.11621E+02	.41250E+01	.54000E+02	.11637E+02	.47475E+01
.54000E+02	.11648E+02	.54144E+01	.54000E+02	.11650E+02	.61245E+01	.54000E+02	.11644E+02	.68754E+01
.54000E+02	.11627E+02	.76641E+01	.54000E+02	.11597E+02	.84864E+01	.54000E+02	.11552E+02	.93375E+01
.54000E+02	.11489E+02	.10211E+02	.54000E+02	.11405E+02	.11101E+02	.54000E+02	.11297E+02	.12000E+02

I = 16 J = 26 (X,Y,Z)

.54000E+02	.15000E+02	0.	.54000E+02	.15000E+02	.30146E+00	.54000E+02	.15000E+02	.61140E+00
.54000E+02	.15000E+02	.93746E+00	.54000E+02	.15000E+02	.12864E+01	.54000E+02	.15000E+02	.16641E+01
.54000E+02	.15000E+02	.20754E+01	.54000E+02	.15000E+02	.25245E+01	.54000E+02	.15000E+02	.30144E+01
.54000E+02	.15000E+02	.35475E+01	.54000E+02	.15000E+02	.41250E+01	.54000E+02	.15000E+02	.47475E+01
.54000E+02	.15000E+02	.54144E+01	.54000E+02	.15000E+02	.61245E+01	.54000E+02	.15000E+02	.68754E+01
.54000E+02	.15000E+02	.76641E+01	.54000E+02	.15000E+02	.84864E+01	.54000E+02	.15000E+02	.93375E+01
.54000E+02	.15000E+02	.10211E+02	.54000E+02	.15000E+02	.11101E+02	.54000E+02	.15000E+02	.12000E+02
I = 21 J = 1 (X,Y,Z)								
.72000E+02	.49315E+01	0.	.72000E+02	.49314E+01	.30146E+00	.72000E+02	.49310E+01	.61140E+00
.72000E+02	.49304E+01	.93746E+00	.72000E+02	.49294E+01	.12864E+01	.72000E+02	.49280E+01	.16641E+01
.72000E+02	.49260E+01	.20754E+01	.72000E+02	.49234E+01	.25245E+01	.72000E+02	.49200E+01	.30144E+01
.72000E+02	.49156E+01	.35475E+01	.72000E+02	.49100E+01	.41250E+01	.72000E+02	.49030E+01	.47475E+01
.72000E+02	.48945E+01	.54144E+01	.72000E+02	.48842E+01	.61245E+01	.72000E+02	.48718E+01	.68754E+01
.72000E+02	.48574E+01	.76641E+01	.72000E+02	.48406E+01	.84864E+01	.72000E+02	.48215E+01	.93375E+01
.72000E+02	.47999E+01	.10211E+02	.72000E+02	.47760E+01	.11101E+02	.72000E+02	.47498E+01	.12000E+02
I = 21 J = 6 (X,Y,Z)								
.72000E+02	.56371E+01	0.	.72000E+02	.57010E+01	.30146E+00	.72000E+02	.57481E+01	.61140E+00
.72000E+02	.57840E+01	.93746E+00	.72000E+02	.58120E+01	.12864E+01	.72000E+02	.58337E+01	.16641E+01
.72000E+02	.58504E+01	.20754E+01	.72000E+02	.58625E+01	.25245E+01	.72000E+02	.58707E+01	.30144E+01
.72000E+02	.58753E+01	.35475E+01	.72000E+02	.58764E+01	.41250E+01	.72000E+02	.58740E+01	.47475E+01
.72000E+02	.58682E+01	.54144E+01	.72000E+02	.58586E+01	.61245E+01	.72000E+02	.58449E+01	.68754E+01
.72000E+02	.58262E+01	.76641E+01	.72000E+02	.58007E+01	.84864E+01	.72000E+02	.57655E+01	.93375E+01
.72000E+02	.57136E+01	.10211E+02	.72000E+02	.56290E+01	.11101E+02	.72000E+02	.54681E+01	.12000E+02
I = 21 J = 11 (X,Y,Z)								
.72000E+02	.68614E+01	0.	.72000E+02	.69527E+01	.30146E+00	.72000E+02	.70308E+01	.61140E+00
.72000E+02	.70989E+01	.93746E+00	.72000E+02	.71586E+01	.12864E+01	.72000E+02	.72110E+01	.16641E+01
.72000E+02	.72564E+01	.20754E+01	.72000E+02	.72946E+01	.25245E+01	.72000E+02	.73258E+01	.30144E+01
.72000E+02	.73498E+01	.35475E+01	.72000E+02	.73665E+01	.41250E+01	.72000E+02	.73758E+01	.47475E+01
.72000E+02	.73772E+01	.54144E+01	.72000E+02	.73702E+01	.61245E+01	.72000E+02	.73535E+01	.68754E+01
.72000E+02	.73250E+01	.76641E+01	.72000E+02	.72807E+01	.84864E+01	.72000E+02	.72141E+01	.93375E+01
.72000E+02	.71137E+01	.10211E+02	.72000E+02	.69595E+01	.11101E+02	.72000E+02	.67145E+01	.12000E+02
I = 21 J = 16 (X,Y,Z)								
.72000E+02	.88751E+01	0.	.72000E+02	.89577E+01	.30146E+00	.72000E+02	.90334E+01	.61140E+00
.72000E+02	.91040E+01	.93746E+00	.72000E+02	.91703E+01	.12864E+01	.72000E+02	.92323E+01	.16641E+01
.72000E+02	.92897E+01	.20754E+01	.72000E+02	.93416E+01	.25245E+01	.72000E+02	.93872E+01	.30144E+01
.72000E+02	.94253E+01	.35475E+01	.72000E+02	.94550E+01	.41250E+01	.72000E+02	.94750E+01	.47475E+01
.72000E+02	.94842E+01	.54144E+01	.72000E+02	.94811E+01	.61245E+01	.72000E+02	.94638E+01	.68754E+01
.72000E+02	.94291E+01	.76641E+01	.72000E+02	.93730E+01	.84864E+01	.72000E+02	.92890E+01	.93375E+01
.72000E+02	.91685E+01	.10211E+02	.72000E+02	.89991E+01	.11101E+02	.72000E+02	.87646E+01	.12000E+02

I = 21 J = 21 (X,Y,Z)								
.72000E+02	.11678E+02	0.	.72000E+02	.11727E+02	.30146E+00	.72000E+02	.11773E+02	.61140E+00
.72000E+02	.11817E+02	.93746E+00	.72000E+02	.11859E+02	.12864E+01	.72000E+02	.11900E+02	.16641E+01
.72000E+02	.11939E+02	.20754E+01	.72000E+02	.11975E+02	.25245E+01	.72000E+02	.12007E+02	.30144E+01
.72000E+02	.12036E+02	.35475E+01	.72000E+02	.12058E+02	.41250E+01	.72000E+02	.12074E+02	.47475E+01
.72000E+02	.12083E+02	.54144E+01	.72000E+02	.12082E+02	.61245E+01	.72000E+02	.12071E+02	.68754E+01
.72000E+02	.12047E+02	.76641E+01	.72000E+02	.12008E+02	.84864E+01	.72000E+02	.11950E+02	.93375E+01
.72000E+02	.11869E+02	.10211E+02	.72000E+02	.11760E+02	.11101E+02	.72000E+02	.11618E+02	.12000E+02

I = 21 J = 26 (X,Y,Z)								
.72000E+02	.15000E+02	0.	.72000E+02	.15000E+02	.30146E+00	.72000E+02	.15000E+02	.61140E+00
.72000E+02	.15000E+02	.93746E+00	.72000E+02	.15000E+02	.12864E+01	.72000E+02	.15000E+02	.16641E+01
.72000E+02	.15000E+02	.20754E+01	.72000E+02	.15000E+02	.25245E+01	.72000E+02	.15000E+02	.30144E+01
.72000E+02	.15000E+02	.35475E+01	.72000E+02	.15000E+02	.41250E+01	.72000E+02	.15000E+02	.47475E+01
.72000E+02	.15000E+02	.54144E+01	.72000E+02	.15000E+02	.61245E+01	.72000E+02	.15000E+02	.68754E+01
.72000E+02	.15000E+02	.76641E+01	.72000E+02	.15000E+02	.84864E+01	.72000E+02	.15000E+02	.93375E+01
.72000E+02	.15000E+02	.10211E+02	.72000E+02	.15000E+02	.11101E+02	.72000E+02	.15000E+02	.12000E+02

I = 26 J = 1 (X,Y,Z)								
.90000E+02	.54589E+01	0.	.90000E+02	.54586E+01	.30146E+00	.90000E+02	.54577E+01	.61140E+00
.90000E+02	.54560E+01	.93746E+00	.90000E+02	.54535E+01	.12864E+01	.90000E+02	.54498E+01	.16641E+01
.90000E+02	.54448E+01	.20754E+01	.90000E+02	.54380E+01	.25245E+01	.90000E+02	.54291E+01	.30144E+01
.90000E+02	.54177E+01	.35475E+01	.90000E+02	.54032E+01	.41250E+01	.90000E+02	.53851E+01	.47475E+01
.90000E+02	.53629E+01	.54144E+01	.90000E+02	.53361E+01	.61245E+01	.90000E+02	.53041E+01	.68754E+01
.90000E+02	.52665E+01	.76641E+01	.90000E+02	.52230E+01	.84864E+01	.90000E+02	.51732E+01	.93375E+01
.90000E+02	.51172E+01	.10211E+02	.90000E+02	.50550E+01	.11101E+02	.90000E+02	.49868E+01	.12000E+02

I = 26 J = 6 (X,Y,Z)								
.90000E+02	.61275E+01	0.	.90000E+02	.61273E+01	.30146E+00	.90000E+02	.61264E+01	.61140E+00
.90000E+02	.61249E+01	.93746E+00	.90000E+02	.61225E+01	.12864E+01	.90000E+02	.61191E+01	.16641E+01
.90000E+02	.61144E+01	.20754E+01	.90000E+02	.61081E+01	.25245E+01	.90000E+02	.60999E+01	.30144E+01
.90000E+02	.60892E+01	.35475E+01	.90000E+02	.60757E+01	.41250E+01	.90000E+02	.60589E+01	.47475E+01
.90000E+02	.60383E+01	.54144E+01	.90000E+02	.60133E+01	.61245E+01	.90000E+02	.59836E+01	.68754E+01
.90000E+02	.59486E+01	.76641E+01	.90000E+02	.59082E+01	.84864E+01	.90000E+02	.58619E+01	.93375E+01
.90000E+02	.58098E+01	.10211E+02	.90000E+02	.57519E+01	.11101E+02	.90000E+02	.56886E+01	.12000E+02

I = 26 J = 11 (X,Y,Z)								
.90000E+02	.72877E+01	0.	.90000E+02	.72875E+01	.30146E+00	.90000E+02	.72867E+01	.61140E+00
.90000E+02	.72854E+01	.93746E+00	.90000E+02	.72834E+01	.12864E+01	.90000E+02	.72804E+01	.16641E+01
.90000E+02	.72763E+01	.20754E+01	.90000E+02	.72709E+01	.25245E+01	.90000E+02	.72637E+01	.30144E+01
.90000E+02	.72544E+01	.35475E+01	.90000E+02	.72427E+01	.41250E+01	.90000E+02	.72281E+01	.47475E+01
.90000E+02	.72101E+01	.54144E+01	.90000E+02	.71885E+01	.61245E+01	.90000E+02	.71626E+01	.68754E+01
.90000E+02	.71322E+01	.76641E+01	.90000E+02	.70970E+01	.84864E+01	.90000E+02	.70568E+01	.93375E+01
.90000E+02	.70115E+01	.10211E+02	.90000E+02	.69612E+01	.11101E+02	.90000E+02	.69062E+01	.12000E+02

I = 26 J = 16 (X,Y,Z)

.90000E+02	.91960E+01	0.	.90000E+02	.91958E+01	.30146E+00	.90000E+02	.91952E+01	.61140E+00
.90000E+02	.91942E+01	.93746E+00	.90000E+02	.91927E+01	.12864E+01	.90000E+02	.91904E+01	.16641E+01
.90000E+02	.91874E+01	.20754E+01	.90000E+02	.91833E+01	.25245E+01	.90000E+02	.91779E+01	.30144E+01
.90000E+02	.91709E+01	.35475E+01	.90000E+02	.91621E+01	.41250E+01	.90000E+02	.91511E+01	.47475E+01
.90000E+02	.91376E+01	.54144E+01	.90000E+02	.91212E+01	.61245E+01	.90000E+02	.91018E+01	.68754E+01
.90000E+02	.90789E+01	.76641E+01	.90000E+02	.90524E+01	.84864E+01	.90000E+02	.90222E+01	.93375E+01
.90000E+02	.89881E+01	.10211E+02	.90000E+02	.89502E+01	.11101E+02	.90000E+02	.89088E+01	.12000E+02

I = 26 J = 21 (X,Y,Z)

.90000E+02	.11852E+02	0.	.90000E+02	.11852E+02	.30146E+00	.90000E+02	.11852E+02	.61140E+00
.90000E+02	.11851E+02	.93746E+00	.90000E+02	.11850E+02	.12864E+01	.90000E+02	.11849E+02	.16641E+01
.90000E+02	.11848E+02	.20754E+01	.90000E+02	.11845E+02	.25245E+01	.90000E+02	.11842E+02	.30144E+01
.90000E+02	.11839E+02	.35475E+01	.90000E+02	.11834E+02	.41250E+01	.90000E+02	.11828E+02	.47475E+01
.90000E+02	.11821E+02	.54144E+01	.90000E+02	.11812E+02	.61245E+01	.90000E+02	.11801E+02	.68754E+01
.90000E+02	.11789E+02	.76641E+01	.90000E+02	.11774E+02	.84864E+01	.90000E+02	.11758E+02	.93375E+01
.90000E+02	.11739E+02	.10211E+02	.90000E+02	.11719E+02	.11101E+02	.90000E+02	.11696E+02	.12000E+02

I = 26 J = 26 (X,Y,Z)

.90000E+02	.15000E+02	0.	.90000E+02	.15000E+02	.30146E+00	.90000E+02	.15000E+02	.61140E+00
.90000E+02	.15000E+02	.93746E+00	.90000E+02	.15000E+02	.12864E+01	.90000E+02	.15000E+02	.16641E+01
.90000E+02	.15000E+02	.20754E+01	.90000E+02	.15000E+02	.25245E+01	.90000E+02	.15000E+02	.30144E+01
.90000E+02	.15000E+02	.35475E+01	.90000E+02	.15000E+02	.41250E+01	.90000E+02	.15000E+02	.47475E+01
.90000E+02	.15000E+02	.54144E+01	.90000E+02	.15000E+02	.61245E+01	.90000E+02	.15000E+02	.68754E+01
.90000E+02	.15000E+02	.76641E+01	.90000E+02	.15000E+02	.84864E+01	.90000E+02	.15000E+02	.93375E+01
.90000E+02	.15000E+02	.10211E+02	.90000E+02	.15000E+02	.11101E+02	.90000E+02	.15000E+02	.12000E+02

III. Conclusions and Recommendations

A method for numerically generating three-dimensional coordinate system for a wedge with a curved after body has been presented. The computer program AFTBDY used to numerically generate the coordinate system stores the data on a disk file. This coordinate system will become a part of the input to the three-dimensional Navier-Stokes computer program GANS (developed by Dr. Julius E. Harris at the NASA Langley Research Center). The computer program GANS is a code to solve three dimensional, time split, viscous, compressible Navier-Stokes equations.

No Navier-Stokes computer runs using GANS have been made as yet for a wedge curved after body using the coordinate system generated by the program AFTBDY. There are two areas in program AFTBDY where improvements may have to be made in case the Navier-Stokes solution generates errors which are attributable to the coordinate system.

The first area could be the way the attraction term Q is computed. Q is presently computed based on the y variation on $\xi = 1, \zeta = 1, \eta = 1, JMAX$ line. For all η planes the same value of Q is used. However, as the total y variation from $\eta = 1$ to $\eta = JMAX$ for various ξ and ζ stations changes, this treatment of Q gives η coordinate line variation as shown in Figure 10. Close to the after body, the η lines do not follow the after body contour satisfactorily. This problem can be minimized by choosing Q as a sum of exponential functions as suggested by Thompson, Mastin, and Thames of the Mississippi State University.

The second problem area is the use of Dirichlet boundary conditions on $\zeta = 1$ and $\zeta = KMAX$ planes. This results in abrupt change of slope near the $\zeta = 1$ and $\zeta = KMAX$ planes (Figure 10). This problem can be avoided by using Neumann boundary conditions on these two planes instead of Dirichlet boundary conditions.

IV. Programmer/Analyst Section

Program AFTBDY is structured such that the array size in ξ, η , and ζ direction can be varied from problem to problem by the use of text editor on the CDC 6600 machine. The array sizes are coded to be IMXLL, JMXLL, KMXLL in ξ, η, ζ direction, respectively. These are changed to the appropriate numeric number by the text editor prior to compiling the program. The job control cards, input explanation and other helpful hints are provided towards the beginning of main program AFTBDY. The program is extensively commented. Though, the code is not structured in the true sense, extreme care was taken to avoid unnecessary upward branching in the code. A brief discussion of each subroutine and their function follows.

A. Main Program AFTBDY

This program performs the following function,

- i) Initialize variables to zero.
- ii) Read in input data. If the field size is larger than the maximum field size allowed then the program aborts with a diagnostic message. The maximum size allowed is ILIMIT, JLIMIT, KLIMIT and field size input is IMAX, JMAX, KMAX. ILIMIT, JLIMIT, KLIMIT are set by the text editor. The storage in N.S. code is such that it is necessary to set,

```
ILIMIT = IMAX
JLIMIT = JMAX
KLIMIT = KMAX
```
- iii) Call subroutine INIT to specify initial guess and compute P, Q, and R.
- iv) Call IPRTC to print initial guess.
- v) Call IPLTC to plot initial guess.

- vi) Call CALCOR to iterate for the value of y CALCOR passes back flag KKK = 1 if the solution converges, otherwise KKK remains set to 0.
- vii) Call IPRTC to print partially or converged solution.
- viii) Call IPLTC to plot partially or converged solution.
- ix) If the solution converges, then store solution on unit 1. If the convergence is not reached in ITERM iterations, then a diagnostic message is printed and the solution is not stored on unit 1.

B. Subroutine INIT

This subroutine computes the initial guess and the inhomogeneous terms P, Q, and R.

C. Subroutine CALCOR

This subroutine computes for y. A do loop is set to perform ITERM iterations. Maximum error in y and its I, J, K location is stored in YERRMX, IYERI, IYERJ and IYERK. After each iteration maximum error is checked against the maximum error allowed. If maximum error is less than maximum error allowed, then the flag KKK is set to 1 and an exit from the do loop is taken. If convergence is not reached in ITERM iteration, then the flag KKK remains set to zero.

D. Subroutine IPRTC

This subroutine prints initial guess, partially converged solution or the converged solution. The following flags indicate the status of the solution

ISOLN = 0	Initial guess
ISOLN = 0 and KKK = 0	Partially converged solution
ISOLN = 0 and KKK = 1	Converged solution

In case of ISOLN = 0, IPRT1 flag indicates whether the solution is to be printed or not. IDEL1 and JDEL1 indicate the interval of ξ and η at which the solution is to be printed.

When ISOLN = 1, IPRT2 flag indicates whether the solution is to be printed or not. In this case IDEL2 and JDEL2 take on the same significance as IDEL1 and JDEL1 in the case of the initial guess.

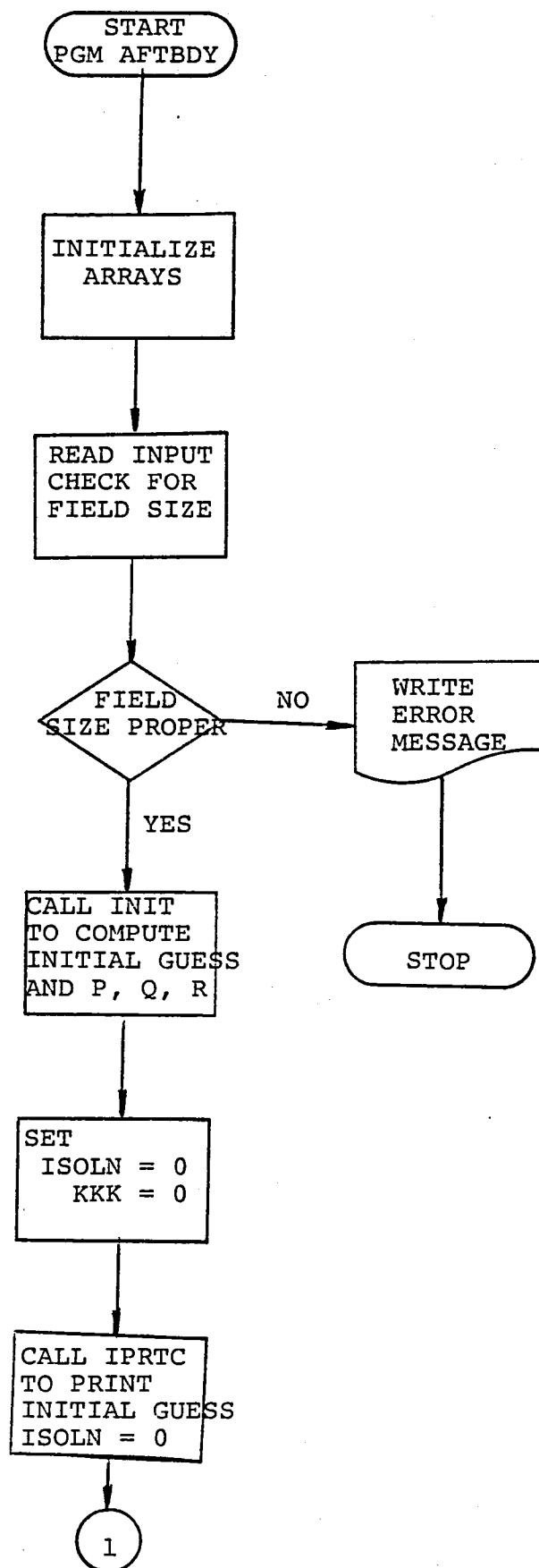
E. Subroutine IPLTC

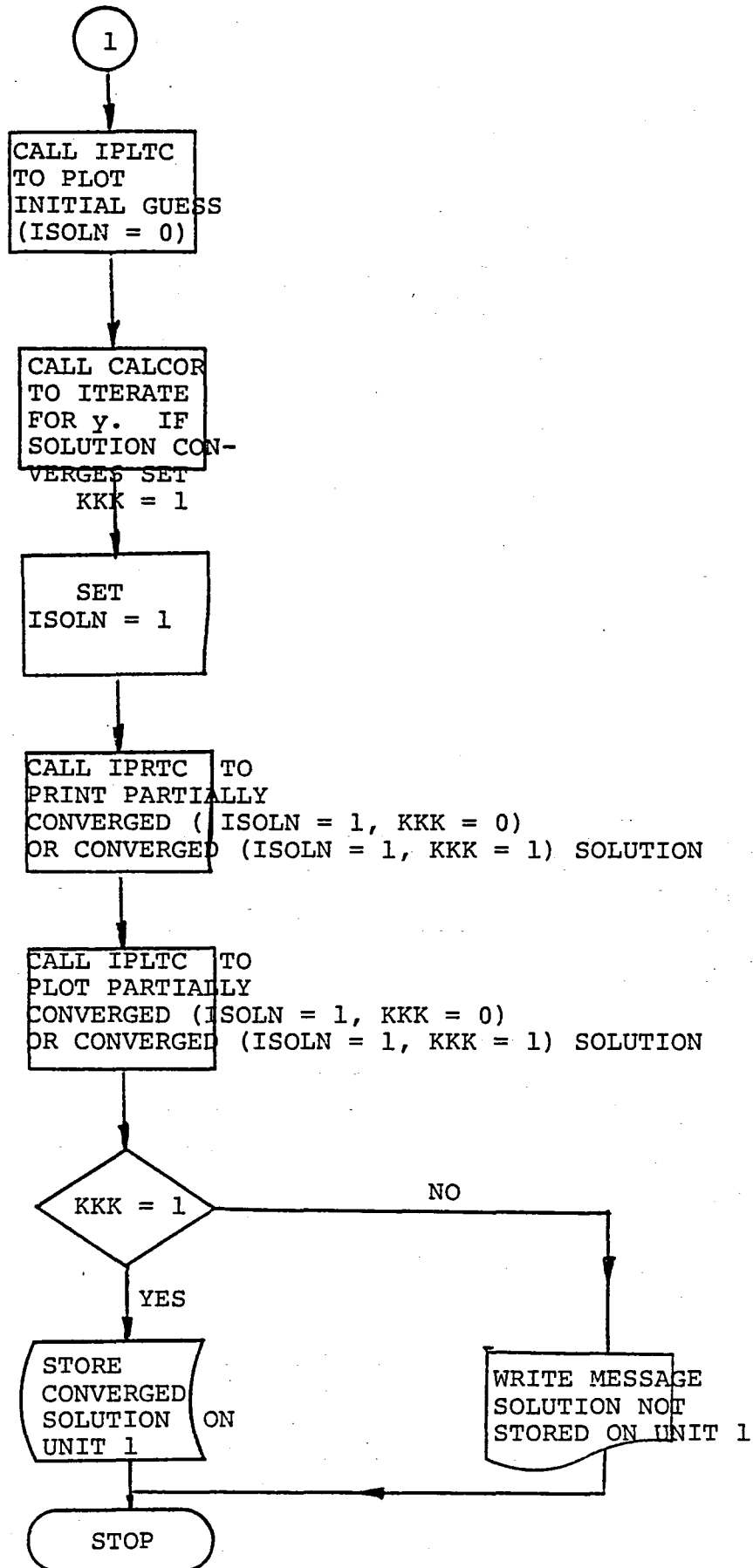
This subroutine is used to plot initial guess, partially converged solution or the converged solution. The flags to indicate the type of solution are the same as in the subroutine IPRTC. This subroutine plots ξ and ζ planes as indicated by input to the program.

F. Block Diagram

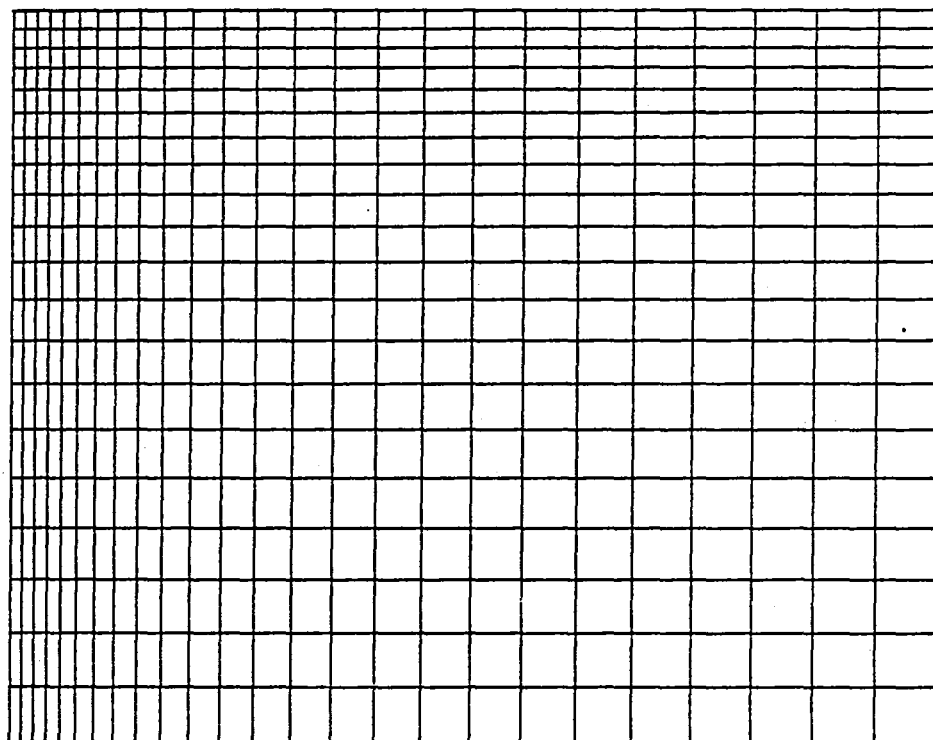
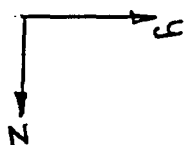
The block diagram is presented on the next page.

F. Block Diagram





AFTER BODY NUMBER 1
TEST STARTED FEB 16,1979
--- INITIAL GUESS ---
IMAX 26 JMAX 26 KMAX 21
-- Y-Z PLOT I 1 X 0.



INFOPLT 1

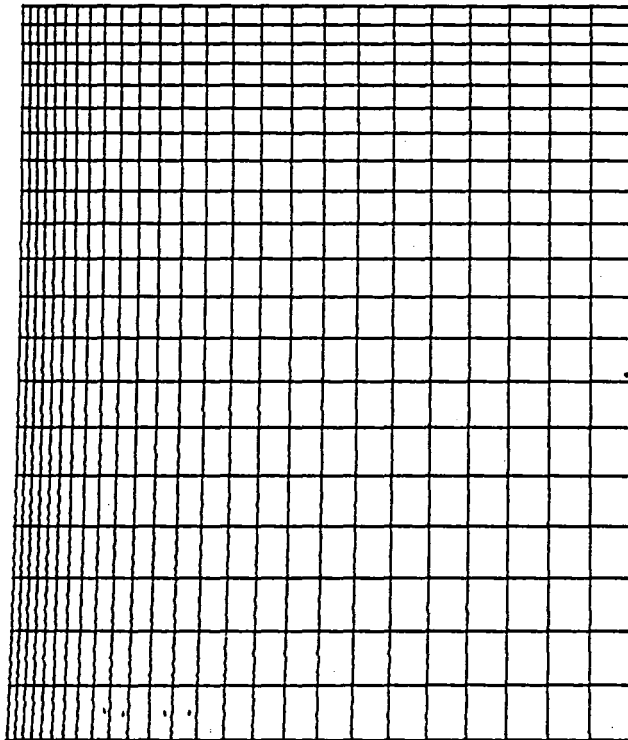
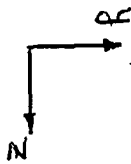
Figure 3. Initial Guess $\xi = 1$ Plane

AFTER BODY NUMBER 1
TEST STARTED FEB 16, 1979

--- INITIAL GUESS ---

IMAX 26 JMAX 26 KMAX 21

-- Y-Z PLOT I 22 X .75600E 02



INFOPLT 2.

Figure 4. Initial Guess $\xi = 22$ Plane

AFTER BODY NUMBER 1
 TEST STARTED FEB 16,1979
 --- INITIAL GUESS ---
 I MAX 26 J MAX 26 K MAX 21
 -- Y-Z PLOT I 26 X .900000E 02

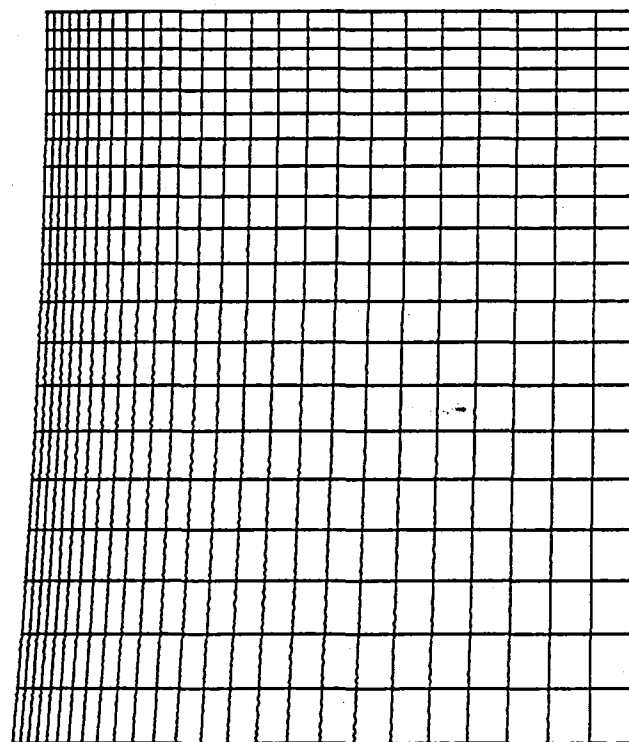
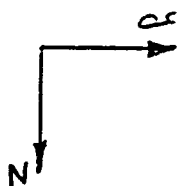


Figure 5. Initial Guess $\xi = 26$ Plane

INFOPLT 3.

AFTER BODY NUMBER 1
TEST STARTED FEB 16, 1979
--- INITIAL GUESS ---
IMAX 26 JMAX 26 KMAX 21
-- X-Y PLOT K 1 Z 0.

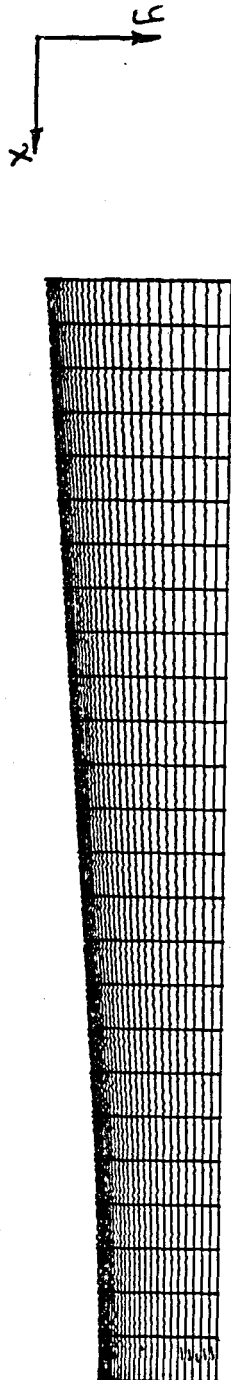


Figure 6. Initial Guess $\zeta = 1$ Plane

AFTER BODY NUMBER 1
TEST STARTED FEB 16, 1979
--- INITIAL GUESS ---
IMAX 26 JMAX 26 KMAX 21
-- X-Y PLOT K 11 Z .41250E 01

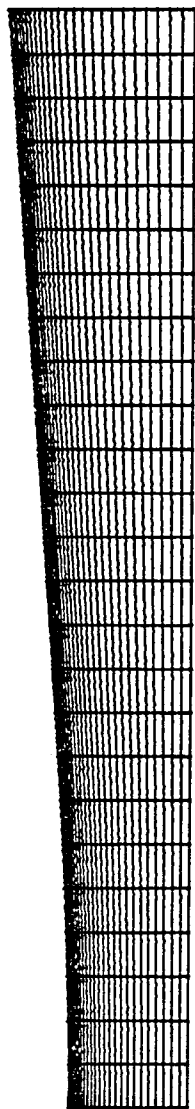
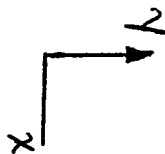


Figure 7. Initial Guess $\zeta = 11$ Plane

AFTER BODY NUMBER 1
TEST STARTED FEB 16, 1979

--- INITIAL GUESS ---

IMAX 26 JMAX 26 KMAX 21

-- X-Y PLOT K 21 Z .12000E 02

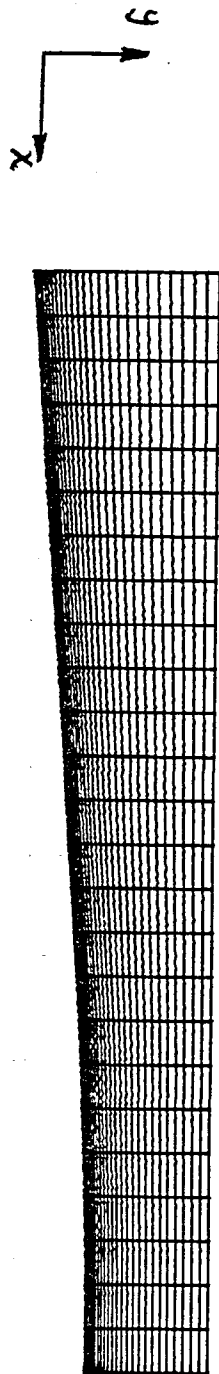
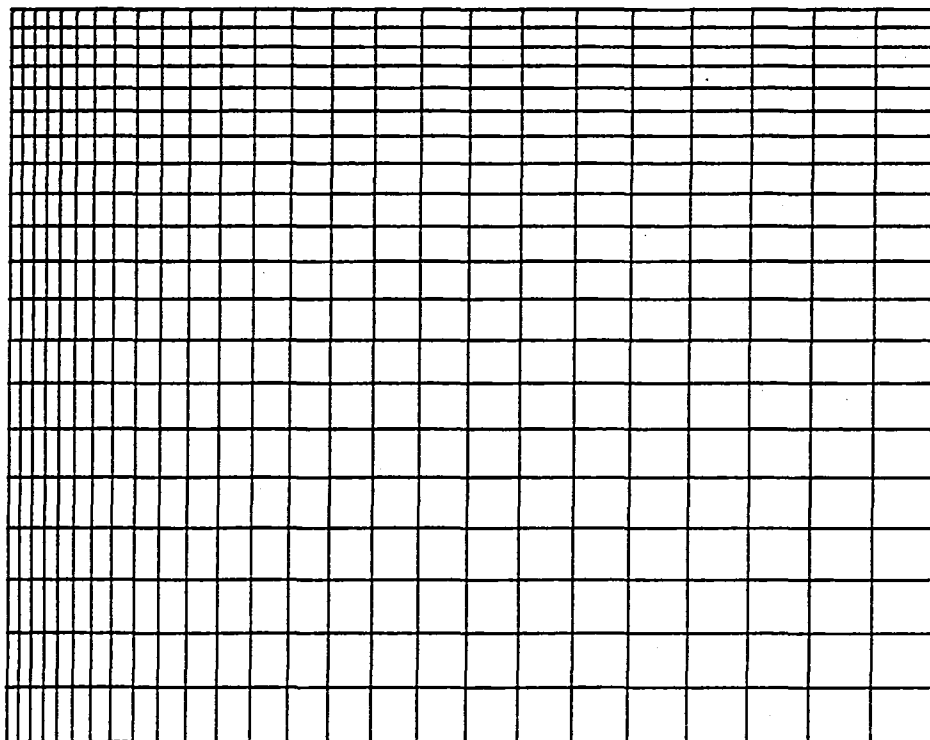
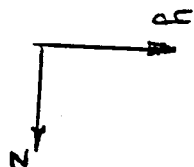


Figure 8. Initial Guess $\zeta = 21$ Plane

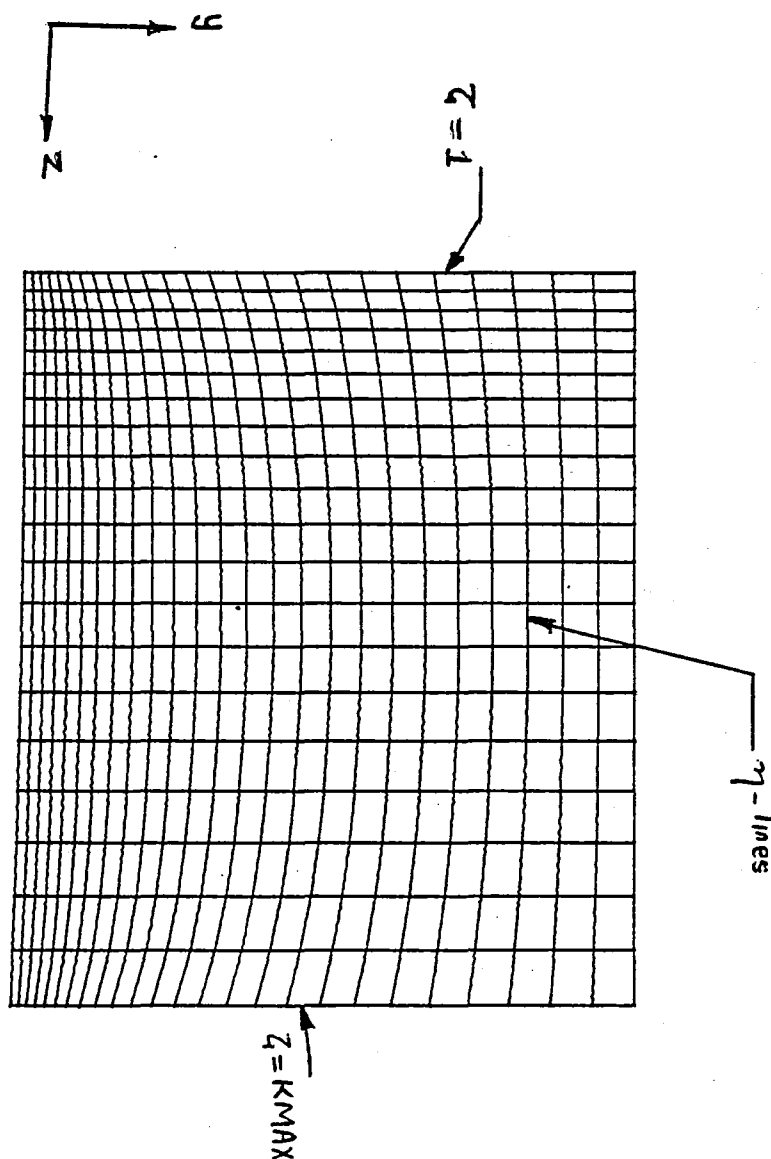
AFTER BODY NUMBER 1
 TEST STARTED FEB 16, 1979
 --- CONVERGED SOLUTION ---
 I MAX 26 J MAX 26 K MAX 21
 -- Y-Z PLOT 1 1 X 0.



INFOPLT 7.

Figure 9. Converged Solution $\xi = 1$ Plane

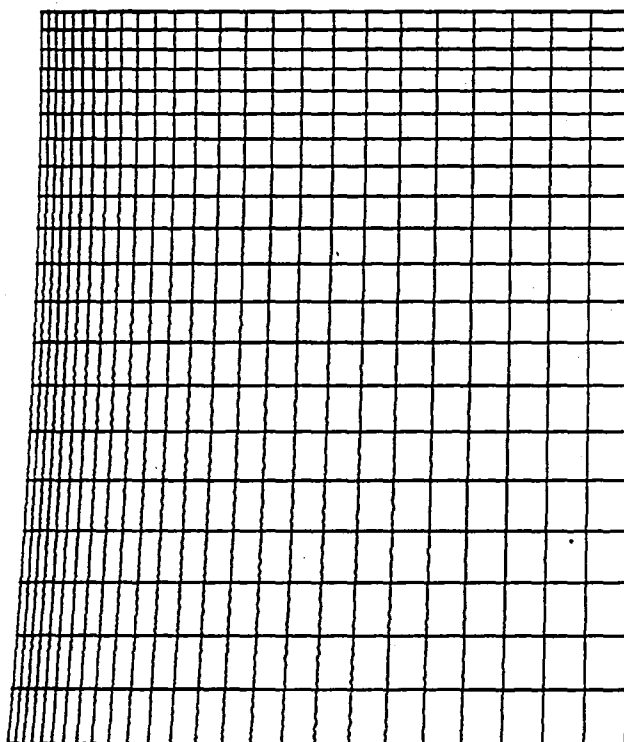
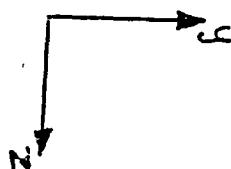
AFTER BODY NUMBER 1
 TEST STARTED FEB 16, 1979
 --- CONVERGED SOLUTION ---
 IMAX 26 JMAX 26 KMAX 21
 -- Y-Z PLOT 1 22 X .75600E 02



INFOPLT 8.

Figure 10. Converged Solution $\xi = 22$

AFTER BODY NUMBER 1
TEST STARTED FEB 16,1979
--- CONVERGED SOLUTION ---
IMAX 26 JMAX 26 KMAX 21
-- Y-Z PLOT I 26 X .90000E 02



INFOPLT 9.

AFTER BODY NUMBER 1
TEST STARTED FEB 16, 1979
--- CONVERGED SOLUTION ---
IMAX 26 JMAX 26 KMAX 21

-- X-Y PLOT K 1 Z 0.

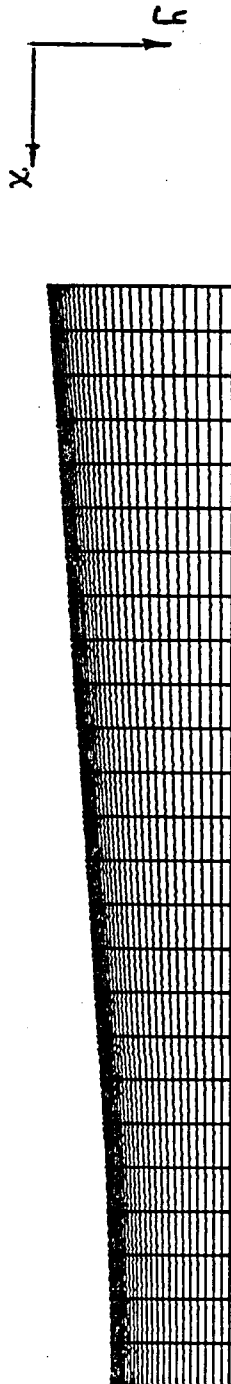


Figure 12. Converged Solution $\zeta = 1$ Plane

AFTER BODY NUMBER 1
TEST STARTED FEB 16, 1979
--- CONVERGED SOLUTION ---
IMAX 26 JMAX 26 KMAX 21
-- X-Y PLOT K 11 Z .41250E 01

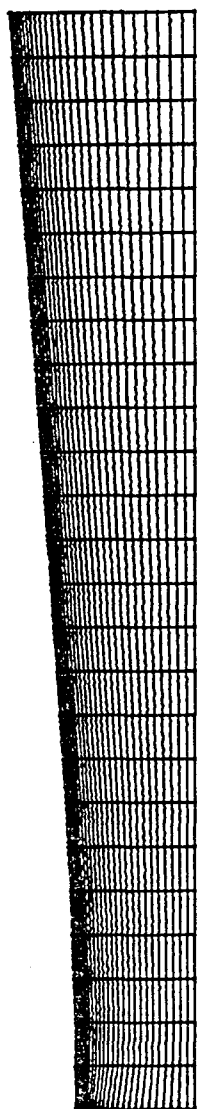
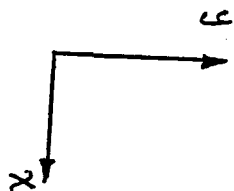


Figure 13. Converged Solution $\zeta = 11$ Plane

AFTER BODY NUMBER 1
TEST STARTED FEB 16, 1979
--- CONVERGED SOLUTION ---
IMAX 26 JMAX 26 KMAX 21
-- X-Y PLOT K 21 Z .12000E 02

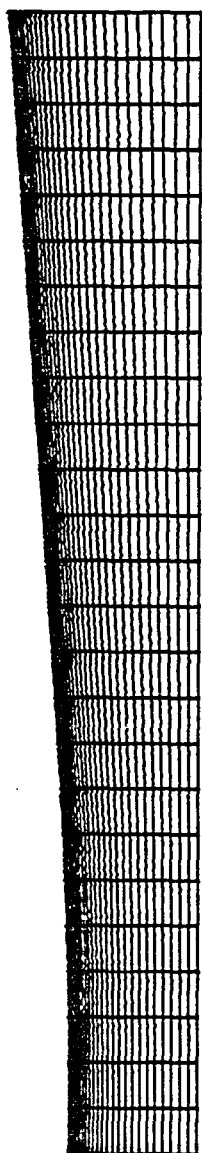
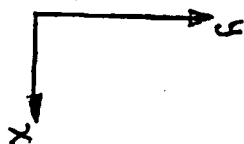


Figure 14. Converged Solution $z = 21$ Plane

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16. Abstract The computer program AFTBDY generates a body-fitted curvilinear coordinate system for a wedge curved after body. (Fig. 1). This wedge curved after body is being used in an experimental program at the Langley Research Center. The coordinate system generated by AFTBDY will be used to solve 3D compressible N.S. equations. The coordinate system in the physical plane is a cartesian x,y,z system, whereas, in the transformed plane a rectangular ξ, η, ζ system is used. The coordinate system generated is such that in the transformed plane coordinate spacing in the ξ, η, ζ direction is constant and equal to unity. The physical plane coordinate lines in the different regions are clustered heavily or sparsely depending on the regions where physical quantities to be solved for by the N.S. equations have high or low gradients. The coordinate distribution in the physical plane is such that x stays constant in η and ζ direction, whereas, z stays constant in ξ and η direction. The desired distribution in x and z is input to the program. Consequently, only the y-coordinate is solved for by the program AFTBDY.					
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